



SANDIA REPORT

SAND99-8004

Unlimited Release

Printed June 1999

Site Environmental Report for 1998

R. C. Holland

Prepared by

Sandia National Laboratories

Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

Approved for public release; further dissemination unlimited.



Sandia National Laboratories

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation.

NOTICE: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, any agency thereof, or any of their contractors or subcontractors. The views and opinions expressed herein do not necessarily state or reflect those of the United States Government, any agency thereof, or any of their contractors.

Printed in the United States of America. This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Prices available from (703) 605-6000
Web site: <http://www.ntis.gov/ordering.htm>

Available to the public from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd
Springfield, VA 22161

NTIS price codes
Printed copy: A06
Microfiche copy: A01



Site Environmental Report For 1998



Author

Robert C. Holland
Environmental Operations
Department

Editor

Robert A. Condouris

Illustrations

Ken Ball

Composition

Sandra K. Simmons

sandia national laboratories/california
SAND99-8004

Acknowledgments

Listed below are the Sandia National Laboratories employees responsible for specific environmental programs. These people contributed to the respective sections of this report.

Environmental Surveillance	Robert C. Holland
Wastewater/Storm Water Control	Janet Harris
Groundwater Monitoring	Robert C. Holland
Waste Management	Sarah O'Connor
Environmental Restoration	Steve Orth
Pollution Prevention	Sally Raubfogel
Environmental Planning	Barbara Larsen
Chemical Information Management	Mark E. Brynildson
Air Quality	Leslee Gardizi

In addition, John Chavarria served as the environmental technician and was responsible for collecting many of the Sandia/California environmental samples. The authors would also like to acknowledge Kristen Kerr and Lily Sanchez, for their significant contributions.

For further information about this report, contact:

Sandia National Laboratories
Public Information Office
P. O. Box 969
Livermore, CA 94551-0969
Attention: Barry Schrader
Phone: (925) 294-2447

The U.S. Department of Energy (DOE) Order 5400.1, General Environmental Protection Programs, establishes requirements for environmental protection programs at DOE sites, including Sandia National Laboratories (SNL). These programs ensure that DOE operations comply with Federal, State, and local environmental laws and regulations, as well as DOE orders and policies. To comply with DOE Order 5400.1, SNL/California has prepared the *Environmental Protection Implementation Plan*.¹ This document provides the framework for SNL/California to implement the DOE's environmental protection goals and to comply with environmental regulations.

To verify effective protection of the environment, SNL/California maintains extensive effluent monitoring and environmental surveillance programs. These programs collect the information necessary to assess how effective pollution control measures are and to characterize the site's impact on the environment. The monitoring program routinely measures the levels of pollutants and radioactive material around the Sandia site and surrounding area. The off-site environmental radiation monitoring data in this report were collected by Lawrence Livermore National Laboratory (LLNL), which monitors outlying areas for both facilities. The SNL/California *Environmental Monitoring Plan* identifies the operations and emissions at the site and describes the effluent monitoring and environmental surveillance programs and activities. These programs and activities are in place to protect the public and the environment. The plan describes exposure pathways (potential routes of human exposure to pollutants), sampling and analysis procedures, radiation dose assessment methods, and quality assurance activities.

The SNL/California Environmental Operations Department is responsible for all environmental programs and activities, including reporting requirements.

Environmental staff maintain various documents describing specific program areas. These documents are referenced in this report, as appropriate.

The SNL/California Environmental Operations Department prepares the *Site Environmental Report* annually, as required by the DOE and other regulatory agencies. It describes the results of SNL/California's environmental protection activities during the calendar year. It also summarizes environmental monitoring data and highlights major environmental programs. Overall, it evaluates SNL/California's environmental management performance and documents the site's regulatory compliance status.

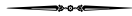
Most importantly, the *Site Environmental Report* serves the needs of the public. It is a key element in our communication with the local community. For this reason, the report contains two summary chapters: Chapter 1, "Executive Summary," and Chapter 3, "Compliance Summary," which highlight and interpret environmental findings and regulatory compliance for the year. These summaries are written for the lay person and use a minimum of technical terminology. We have also included an extensive glossary in the back of the report. It defines acronyms, abbreviations, and technical terms. It also describes radiological nomenclature and conversion information for units used in the report.

The body of the report is a comprehensive description of environmental activities. It provides substantial background information and covers all major environmental programs at SNL/California.

In October 1992, the DOE adopted a public participation policy, which commits to providing the public an opportunity to become involved in the decision-making process for environmental restoration and waste management activities.² To implement this program, SNL/California has developed a formal public participation program. This

Preface

program helps keep the local community members informed of matters that affect them. It also helps the DOE address public values and concerns. As a good corporate citizen, SNL/California has a long-standing policy of openness with the local community, which includes public meetings, site tours, and informational bulletins. Our formal public participation program is designed to further foster cooperation with our neighbors.



References

1. R. C. Holland, Environmental Monitoring Plan, Sandia National Laboratories/California, SAND95-8001 (March 1998).
2. U.S. DOE, SNL/California, *Public Participation Plan* (September 1994).

1 – Executive Summary	
Air Monitoring	1-1
Sewer Monitoring	1-1
Storm Water Monitoring	1-2
External Radiation Monitoring	1-2
Groundwater Monitoring	1-2
Radiation Impact to the Public	1-2
Compliance with Regulations	1-2
Environmental Monitoring Plan	1-3
2 – Introduction	
Environment, Safety, and Health Organization	2-1
Self-Assessment Program	2-2
SNL/California Environment, Safety, and Health Organization	2-3
Environmental Operations Department	2-4
Waste Management	2-4
Environmental Surveillance/Compliance Groundwater Monitoring	2-5
Air Quality	2-5
Environmental Planning	2-5
Site Description	2-6
Laboratory Setting	2-7
Annual Site Environmental Report	2-9
3 – Compliance Summary	
Environmental Monitoring	3-1
Environmental Programs Status	3-1
Other Issues and Actions	3-6
Environmental Permits	3-6
Streambed Alteration	3-8
4 – Environmental Monitoring Program	
Effluent Monitoring Results	4-1
Environmental Surveillance Results	4-10
Environmental Impacts	4-12
5 – Environmental Program Information	
Environmental Restoration Program	5-1
Air Quality Management Program	5-6
Wastewater/Storm Water Control Programs	5-6
Waste Management Programs	5-8
Waste Minimization and Pollution Prevention Awareness Program	5-9
Chemical Information Management	5-11
Toxic Substance Control Act Compliance	5-11
National Environmental Policy Act Compliance	5-11
Performance Measures/Indicators	5-12

Contents

	Page
6 – Groundwater	
Groundwater Sampling	6-1
Analytical Results	6-3
7 – Quality	
Data Quality Assurance	7-1
Data Interpretation	7-2
Glossary	
Acronyms and Abbreviations	GLS-1
Technical Terms	GLS-2
Radiological Units	GLS-7
Appendix A – Laboratory Procedures	
External Radiation	A-1
Sanitary Sewer Effluent	A-1
Liquid Effluent Control Systems	A-1
Storm Water Runoff	A-1
Groundwater	A-1

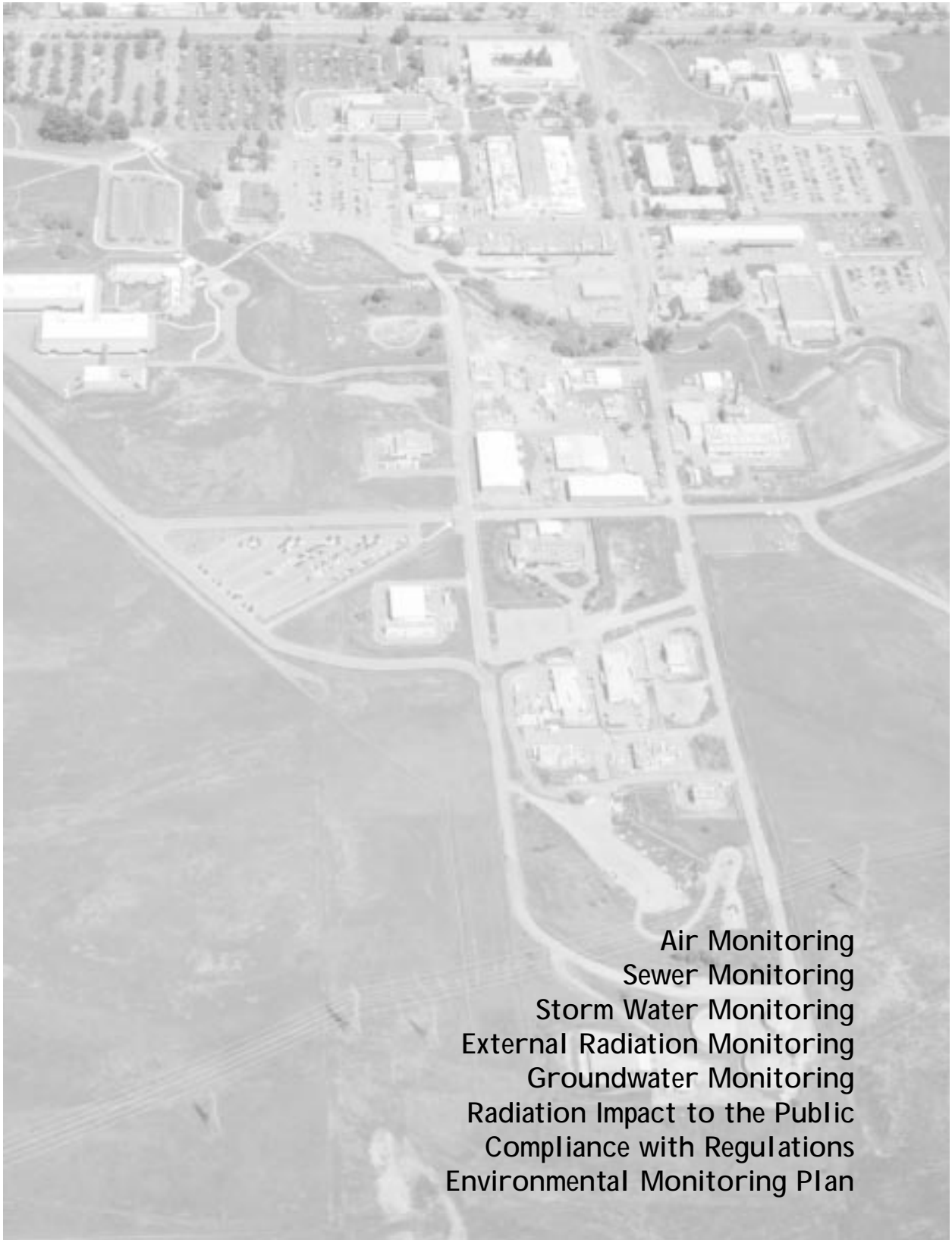
Illustrations

	Page
2-1 Organizational structure of environment, safety, and health at SNL/California	2-2
2-2 Organizational structure of the Environmental Operations Department ...	2-4
2-3 SNL/California in a regional setting	2-7
2-4 Typical groundwater contours at SNL/California	2-8
2-5 SNL/California wetland areas	2-9
3-1 SNL/California EPCRA 313 “top five” chemicals	3-3
4-1 Sewer and LECS locations	4-3
4-2 Copper concentrations in the sanitary sewer	4-6
4-3 Storm water sampling locations on the SNL/California site	4-7
4-4 pH in storm water	4-8
4-5 Total suspended solids in storm water	4-9
4-6 Specific conductivity in storm water	4-9
4-7 Dosimeter locations on the SNL/California site and around the site perimeter	4-11
4-8 Dosimeter locations in the Livermore Valley	4-12
5-1 SNL/California remediation sites	5-1
6-1 Groundwater monitoring well locations on the SNL/California site	6-2
6-2 Highest diesel in any FOS well	6-3
6-3 Highest tritium in SNL/California monitoring wells	6-4

Tables

	Page
3-1 Major Federal Environmental Regulations Applicable to SNL/California	3-9
3-2 SNL/California Bay Area Air Quality Management District Permitted Sources	3-10
3-3 Bay Area Air Quality Management District Exemptions Held by SNL/California in 1998	3-10
3-4 Environmental Audits of SNL/California in 1998	3-10
3-5 Environment-related Occurrence Reports During 1998	3-11
3-6 SNL/California Environmental Permits in 1998	3-11
4-1 Environmental Sampling Program Overview	4-14
5-1 SNL/California Site Waste Reduction Summary	5-14
5-2 SNL/California Site Recycling Activities (Estimated Values)	5-15
6-1 Sample Analysis Schedule	6-5
7-1 Quality Assurance—Duplicate Sampling, Selected Parameters on SNL/California Collected Samples	7-5

1 — Executive Summary



Sandia National Laboratories (SNL) is committed to conducting its operations in an environmentally safe and sound manner. It is mandatory that activities at SNL/California comply with all applicable environmental statutes, regulations, and standards. Moreover, SNL/California continuously strives to reduce risks to employees, the public, and the environment to the lowest levels reasonably possible.

To help verify effective protection of public safety and preservation of the environment, SNL/California maintains an extensive, ongoing environmental monitoring program. This program monitors all significant effluents and the environment at the SNL/California site perimeter. Lawrence Livermore National Laboratory (LLNL) performs off-site external radiation monitoring for both sites. These monitoring efforts ensure that emission controls are effective in preventing contamination of the environment.

As part of SNL/California's Environmental Monitoring Program, an environmental surveillance system measures the possible presence of hazardous materials in groundwater, stormwater, and sewage. The program also includes an extensive environmental dosimetry program, which measures external radiation levels around the Livermore site and nearby vicinity.

Each year, the results of the Environmental Monitoring Program are published in this report, the *Site Environmental Report*. This executive summary focuses on impacts to the environment. Chapter 3, "Compliance Summary," reviews the site's various environmental protection activities and compliance status with applicable environmental regulations.

The effluent monitoring and environmental surveillance results for 1998 show that SNL/California operations had no harmful effects on the environment or

the public. A summary of the monitoring findings is provided below.

Air Monitoring

SNL/California has no routine emissions of radioactive materials to the air, and therefore does not perform ambient air monitoring. Air monitoring data for radionuclides performed by LLNL in the vicinity of the site may still be obtained in the LLNL *Environmental Report 1998*.

Sewer Monitoring

The sanitary sewer effluent from the SNL/California site is monitored continuously and analyzed weekly to ensure compliance with Federal, State, and local wastewater discharge limits. Moreover, SNL/California strives to minimize pollutants in liquid effluents to the lowest levels possible.

In 1998, all liquid effluent from the Sandia sanitary sewer outfall complied with the site outfall discharge limits for regulated physical parameters and Environmental Protection Agency (EPA) priority organic pollutants. Wastewater samples collected at the site outfall on March 21, and March 28, 1998, were above the discharge limit for copper. However, these concentrations did not adversely affect operations at the Livermore Water Reclamation Plant (LWRP).

SNL/California also has a special monitoring program for "categorical processes" subject to EPA wastewater pretreatment standards (Title 40 CFR, Part 433).¹ In 1998, all the liquid effluents from these processes complied with pretreatment discharge standards for metals and organic pollutants.

The DOE and the State of California have established allowable limits for discharging radionuclides into a public sewer system (see Chapter 4).² These limits have been derived to protect the public and the environment. The current discharge permit issued by the City of

Executive Summary

Livermore requires SNL/California to sample the sewer effluent for tritium only during heavy rainfall events. During 1998, no samples were analyzed for tritium.

Storm Water Monitoring

A State-issued industrial storm water National Pollutant Discharge Elimination System (NPDES) general permit and Alameda County stormwater ordinances require SNL/California to effectively eliminate non-storm water discharges and reduce pollutant discharge in rain to the storm drain system to the maximum extent practicable. To comply with these requirements, SNL/California conducts a variety of sampling and inspection activities throughout the year. Storm water runoff is sampled and visually inspected during the wet months. The entire site is inspected quarterly during dry weather for non-stormwater discharges. The site is again inspected annually to evaluate that on-site outdoor activities minimize the amount of pollutants left on the ground, which can enter by storm water runoff.

In 1998, samples were collected from all of the (10) sampling locations. Every effort was made to collect samples within the first 30 minutes of a storm, or as soon as possible thereafter.

No regulatory limits have been set for pollutants in storm water runoff. No pollutants were detected at levels that would be a cause for concern during the 1998 sampling. Analyses included metals, toxic organics, tritium, and physical parameters.

External Radiation Monitoring

SNL/California and LLNL conduct an extensive program to measure external radiation doses at the Livermore site perimeter and throughout the Livermore Valley.

In 1998, the average annual dose, equivalent from external radiation mea-

sured at the Livermore site perimeter was 60 mrem (0.60 mSv). This level was essentially the same as the background radiation dose measured off-site: 62 mrem (0.62 mSv). These measurements demonstrate that no measurable external dose was the result of direct radiation from Livermore site operations during 1998. That is, if a person had resided at the site fence line 24 hours a day, every day in 1998, he or she would not have received any measurable dose of external radiation above the natural background level.

Groundwater Monitoring

SNL/California conducts groundwater monitoring in areas of known contamination, areas of past contamination (that have been cleaned-up), and areas thought to be able to provide early warning of contamination.

Maximum Contaminant Levels (MCLs) were exceeded for components of diesel fuel at the fuel oil spin site; MCLs for metals were exceeded at the closed Trudell Auto Repair site; and the MCL for carbon tetra chloride was exceeded at the closed Navy Landfill Site.

Radiation Impact to the Public

All use of radionuclides at SNL/California with a potential for release of radioactive materials to the air are evaluated and compared to regulatory limits. If required by regulation, dose assessments are performed. No dose assessments were required during 1998.

Compliance with Regulations

SNL/California expends considerable effort to make sure that site operations comply with all applicable Federal, State, and local regulations. The environmental monitoring data demonstrate that all emissions to the environment from SNL/California in 1998 were well within regulatory standards (except for two

wastewater discharge limit exceedances—see Chapter 4). For details of SNL/California's compliance record, see Chapter 3. It summarizes SNL/California's compliance with applicable environmental statutes and regulations for 1998 and discusses current issues related to environmental management.

Environmental Monitoring Plan

SNL/California prepared the *Environmental Monitoring Plan* in accordance with DOE guidelines.³ The plan serves as a guidance document for the Environmental Monitoring Program at SNL/California. When read in conjunction with the Site Environmental Report (which provides the results of the program for the current year), it provides a comprehensive overview of Sandia's Environmental Monitoring Program.

The *Environmental Monitoring Plan* contains a comprehensive review of environmental monitoring at SNL/California, including administrative structure, pathway analysis, effluent monitoring, sampling of environmental media, laboratory procedures and quality assurance. It details the operations of each of these areas and documents the rationale behind the diverse monitoring methods. In addition to documenting the monitoring system, the plan provides an in-depth review of the adequacy and scientific defensibility of SNL/California's monitoring program.

seq., "California Domestic Water Quality and Monitoring" (1995) .

3. R. C. Holland, *Environmental Monitoring Plan*, Sandia National Laboratories/California, SAND93-8011B (February 1997).

References

1. U.S. EPA, Title 40 CFR, Part 433, *Metal Finishing Point Source Category* (July 1994).
2. State of California, *California Code of Regulations*, Title 22, Sections 64400 et



Environment, Safety, and Health Organization
Self-assessment Program
SNL/California Environment, Safety, and Health Organization
Environmental Operations Department
Waste Management
Environmental Surveillance/Compliance Groundwater Monitoring
Air Quality
Environmental Planning
Site Description
Laboratory Setting
Annual Site Environmental Report

The Sandia National Laboratories (SNL) are operated by Sandia Corporation, a wholly-owned subsidiary of the Lockheed Martin Corporation. As the primary management contractor, Sandia Corporation is responsible for the site's operations; environment, safety, health, and quality assurance; and all of the site's administrative functions.

SNL consists of facilities in New Mexico, California, Nevada, and Hawaii. As one of the United States' multipurpose national laboratories, SNL develops solutions to a wide range of problems facing the country. With the end of the Cold War, SNL's traditional national security mission has expanded to include advanced military technology, energy and environmental research, arms control/nonproliferation, and advanced manufacturing technologies. In addition, Sandia is involved in both technology transfer and educational outreach.

Operations at SNL's California facility comprise three broad programmatic areas:

National Security: National security programs involve both nuclear and nonnuclear work. National security activities encompass maintaining the safety, security, and reliability of the nuclear weapons stockpile as well as nonproliferation of weapons of mass destruction and counter proliferation (that is, response to proliferation).

Energy and Environmental Research: This research addresses a broad range of initiatives centered on combustion science and technology. Areas of emphasis include energy resources for a cleaner environment, minimization of the environmental impact of transportation, environmental remediation and pollution prevention, and renewable energy resources.

Integrated Manufacturing

Technologies: This program uses the systems and technology at the site to develop advanced manufacturing techniques, including simulation-based design, concurrent engineering, rapid prototyping technologies, intelligent machines for hazardous and flexible operations, engineered processes and materials, environmental protection and control, and an infrastructure to support product realization. Our aim is to be an agile manufacturing test bed for low-cost prototypes and development.

SNL/California incorporates the highest regard for environment, safety, and health (ES&H) into every experiment and all site operations. SNL/California operates under the scope of federal, state, and local regulatory authorities and has obtained all appropriate operating permits. Sandia is committed to operate in full compliance with the letter and spirit of applicable environmental laws, regulations, and standards. Furthermore, SNL/California strives to go beyond compliance with legal requirements by making every effort practical to reduce impacts to the environment to levels as low as reasonably achievable.

Environment, Safety, and Health Organization

SNL/California has established a corporate-level ES&H organization. The SNL president has overall responsibility for ES&H. Together, they are ultimately responsible for establishing and communicating a corporate culture that considers the protection and preservation of the environment and the safety and health of its personnel, contractors, visitors, and the public, to be critical to Sandia's success.

SNL/California has an ES&H organization to carry out the corporate ES&H

Introduction

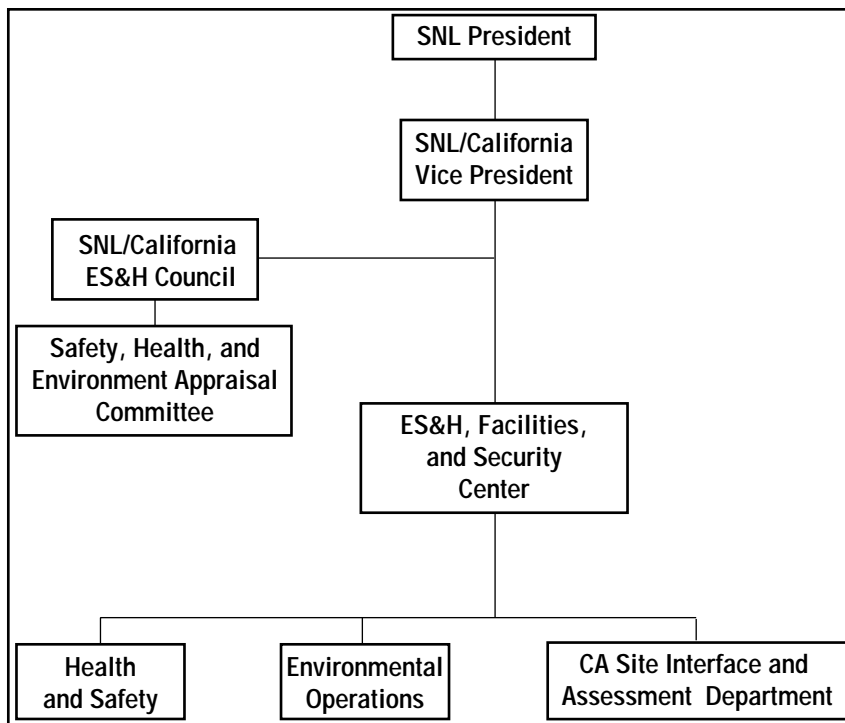


Figure 2-1. Organizational structure of environment, safety, and health at SNL/California.

vision. Its structure is shown in Fig. 2-1. This organization implements ES&H programs and ensures compliance with regulations specific to the California site.

To help assure that ES&H commitments are fulfilled, SNL/California has established a Sandia/California ES&H Council (SCEC). The SCEC ensures top-level management involvement in developing and monitoring ES&H goals. It establishes, promotes, and communicates a culture that recognizes ES&H as a top priority at the California site. The SCEC also provides leadership and consistency of approach in the SNL/California ES&H program. It provides a mechanism for organizational communication—both horizontally and vertically.

The ES&H departments provide oversight of management-related ES&H activities and provides direct ES&H assurance information to the SNL/California vice president. The departments ensure uniform implementation of corporate ES&H

management processes through the use of organizational ES&H coordinators. Additionally, the departments conduct internal audits and self-assessments of the SNL/California's ES&H management processes.

Self-assessment Program

SNL/California ES&H self-assessment process was implemented as part of feedback and improvement of Division 8000's Integrated Safety Management System in April 1998. The sites ES&H self-assessment process falls under the umbrella of Chapter 22 of the *ES&H Manual*. Sandia California's ES&H *Self-Assessment Operating Procedure* (OP471726) documents its process elements: responsi-

bilities, planning, scheduling, information gathering, tracking, verifying, analyzing, evaluating, and reporting. The annual planning for ES&H self-assessments at the California Site is completed by November 15 of each year and annual assessments begin January of each calendar year. Management Surveillance and Management Inspection are both encompassed in Sandia California's ES&H self-assessment process.

The site's self-assessment activities assess both line implementation and ES&H functional programs. ES&H safety committees and managers primarily perform line implementation self-assessments. Functional program self-assessments are performed by the site's ES&H subject matter experts (SMEs); although, the use of Quality Assurance, Sandia/New Mexico SMEs, independent contractors, or other DOE Lab personnel is allowed.

SNL/California's ES&H self-assessments are conducted both annually and

over a 3-year period. Management self-assessments are conducted such that all work space is assessed annually for ES&H concerns by a team consisting of the responsible Manager, an ES&H Coordinator, and a Zone Manager. Safety Committee self-assessments primarily made up of line staff and an SME are conducted, at a minimum quarterly, such that a sampling of operations onsite is reviewed at least every 3 years, unless required otherwise. Functional Program self-assessments are conducted such that a sampling of each program element is assessed at least every 3 years, unless required otherwise. Each Functional Program Self-Assessment is conducted within a 7-workday time frame to ensure that other program responsibilities can be met.

Findings generated by SNL/California's ES&H self-assessments are documented in the site's audit database. Corrective actions are documented in the site's audit database and tracked in the site's web-based tracking database. Managers are responsible for tracking and closing out corrective actions in the site's web-based tracking database. Communication of corrective actions at the worker level is the manager's responsibility.

The self-assessment results are reported to California site's Safety Health and Environment Appraisal Committee (SHEAC) quarterly. Annually, the data are reported to SHEAC for review of strengths, weaknesses, and trends. The results of SNL/California's ES&H self-assessments are also included quarterly in the Corporate ES&H Report. CY98 data establish SNL/California's ES&H self-assessment baseline. Broad general results of the assessments in CY98 include:

- 100% of the self-assessments scheduled in the site's CY98 Annual Self-Assessment Plan were conducted.
- 92% of those conducted were documented and tracked in CY98.

- Of the 330 findings identified as of 12/31/98, 289 were closed, 27 were open, and 14 were overdue.

The objectives of SNL/California's ES&H self-assessments are to measure improvement in the implementation of the Integrated Safety Management System (ISMS) and to help ensure that the California site meets the Corporate Performance Objectives:

- protect the people,
- protect the environment,
- comply with regulations, and
- use good management practices.

SNL/California Environment, Safety, and Health Organization

The organization responsible for ES&H at SNL/California is the Outreach, ES&H, and Security Center. An important part of the center's mission is to ensure the health and safety of SNL/California employees and the general public, and to protect the environment. This mission is fulfilled by helping SNL/California employees understand and comply with DOE orders and their legal responsibilities under federal, state, and local laws and regulations. The Outreach, ES&H, and Security Center has three departments involved in ensuring workplace safety and protection of the environment: Health Protection, CA Site Interface & Assessment, and Environmental Operations.

The Environmental Operations Department is responsible for ensuring that operations at SNL/California are conducted in an environmentally responsible manner and in compliance with applicable laws and regulations. Department personnel contribute their expertise and services to guide and support other SNL/California departments in achieving their missions and goals. They are directly responsible for this report and the activities described herein. Therefore, their specific responsibilities are described below.

Introduction

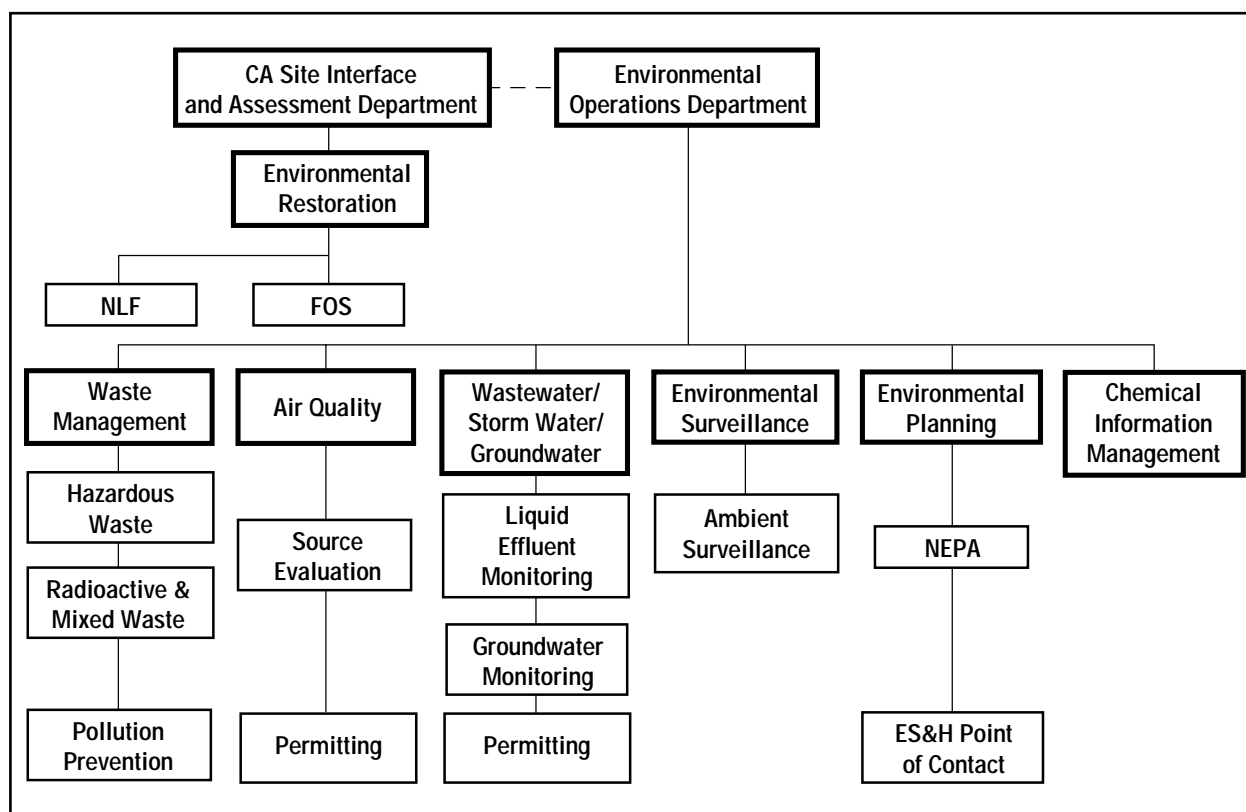


Figure 2-2. Organizational structure of the Environmental Operations Department.

Environmental Operations Department

The Environmental Operations Department maintains a variety of programs to monitor the environmental impacts of site emissions, to preserve the quality of the environment, and to properly manage (minimize and dispose of) hazardous waste. To fulfill its mission, the department has groups responsible for waste management, pollution prevention, environmental surveillance, air quality, chemical information management, environmental planning, and wastewater/storm water management (Fig. 2-2). The following sections briefly describe the activities of these groups.

Waste Management

The Waste Management Program is responsible for managing radioactive,

mixed, medical, energetic, and hazardous wastes. Waste management activities include the collection, onsite transport, storage, treatment, packaging, and shipment of wastes in accordance with DOE, EPA, and state-specified regulations and requirements. The group also manages the following Waste Management Program activities: training, permitting, reporting, interfacing with regulators through the DOE, program planning, record keeping, and budgeting.

The Waste Management Group is responsible for operations conducted in the Hazardous Waste Storage Facility, and the Radioactive and Mixed Waste Storage Facility. In addition, the group manages the permitting of two on-site neutralization facilities that are regulated under “tiered permitting.”

Pollution Prevention

The Pollution Prevention Program is responsible for promoting pollution prevention and source reduction of all wastes in all site activities. Responsibilities include:

- gathering process information,
- assisting in and evaluating pollution prevention,
- fostering employee awareness of pollution prevention and source reduction issues and technologies, and
- developing and maintaining site recycling programs.

The Pollution Prevention Program also is responsible for preparing reports to the DOE and to federal, state, and local regulators. SNL/California has a waste-minimization/pollution-prevention coordinator to manage these efforts.

Environmental Restoration

The Environmental Restoration Program is responsible for assessing the extent of historical contamination of SNL/California sites and managing any necessary restoration efforts.

Environmental Surveillance/Compliance Groundwater Monitoring

The Environmental Surveillance Program at SNL/California assesses potential impacts to the public and the environment from site operations. The group is responsible for ensuring that SNL/California complies with federal, state, and local regulations and with DOE orders governing protection of the environment. Specifically, environmental surveillance personnel maintain a direct radiation monitoring system, and ensure SNL/California's compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) Rule for Radionuclides, under the Federal Clean Air Act (CAA), and DOE orders. This group is also responsible for the monitoring of groundwater in compliance with

state regulations. The group also performs computer modeling of potential emissions to document compliance with these regulations. The group uses these systems to monitor the general environment of SNL/California and nearby vicinity to verify that emission controls are effective in preserving the local environs. The group also prepares numerous reports and other documents to demonstrate compliance.

Air Quality

The Air Quality Program manages a program to facilitate site compliance with regulations governing air emissions to the environment. The Air Quality Compliance Program maintains the site air emissions inventory and evaluates Sandia operations that are potential sources of air pollutants.

Chemical Information Management

The Chemical Information Management Program is responsible for providing consultation for chemical analysis and data review and for maintaining the site-wide Chemical Information System/Material Safety Data Sheet system (MSDS). This system is a UNIX-based relational database containing comprehensive information for tracking chemicals used at SNL/California. It includes a site-wide chemical inventory of more than 40,000 bar-coded chemical containers and potential, personnel chemical-exposure data. The system also manages more than 60,000 Material Safety Data Sheets, which are available to all site personnel on the SNL Internal Web. The system includes hazardous, radioactive, and mixed waste tracking information.

Environmental Planning

The Environmental Planning Program is responsible for implementing the Sandia NEPA program at the California site. This responsibility involves interfacing with DOE on all NEPA issues, coordinating the

Introduction

NEPA review process, and evaluating proposed projects, activities, and programs for potential effects on the physical and human environment. Key concerns addressed during the NEPA evaluation process include air emissions; biological and cultural resources; human exposure to hazardous substances, equipment, or processes; waste generation and minimization; and water effluent.

In addition, the Environmental Planning Program acts as the point of contact for the ES&H Interdisciplinary Team, which comprises representatives from each of the primary disciplines within ES&H. The Interdisciplinary Team is responsible for helping SNL/California's project teams consider ES&H issues as they plan and implement new projects or change ongoing projects. By reviewing proposed projects early in the planning stages, the Interdisciplinary Team helps to ensure projects and experiments are conducted safely and on schedule.

Wastewater/Storm Water/Management

The Wastewater/Storm Water Management Program is responsible for ensuring that SNL/California complies with all federal, state, and local regulations and DOE orders regarding the quality of wastewater and storm water discharges. The group performs the following operations:

- Monitors these discharges both visually and through sampling and analysis.
- Verifies that wastewater and storm water discharges are in compliance with established standards and requirements.
- Prepares numerous reports, permit applications, and other documents to demonstrate compliance with various environmental regulations and DOE orders.
- Implements controls to ensure that SNL/California site activities do not impact the quality of surface waters in the vicinity or in the San Francisco

Bay (to which site storm water drains).

Site Description

This section provides an overview of the SNL/California site, the physical environment, and the ecological characteristics of the area.

Laboratory Facility

The SNL/California site covers 1.7 km² (413 acres), which includes 213 acres of developed areas. In 1986 and 1987, the DOE acquired 228 acres to provide a security buffer zone between developed areas and the Laboratory.

The site facilities comprise approximately 74,400 m² (801,000 ft²) of building floor space. Of this, about 31% is office and drafting areas, 48% is light laboratories and shops, and 3% is heavy laboratories (e.g., high-pressure test facilities and explosives chambers). The remaining 18% is classified as miscellaneous usage, such as computer rooms and library space.

Because SNL/California is a multi-programmatic laboratory involved in a broad range of research and development, facilities are designed for small-scale scientific and applied engineering research. The site has neither production nor large-scale manufacturing operations.

Airborne Emissions

SNL/California has sources of uranium, principally depleted uranium. All operations with the potential to emit uranium are controlled by both administrative and physical controls. Any operation with the potential to emit radionuclides to the environment undergoes an evaluation in accordance with NESHAPs. Nonradiological emissions include nitrogen oxides (NO_x), particulates, and precursor organic compounds.

Water Supply and Sewer Effluent

The site's water supply normally comes from the Hetch Hetchy Aqueduct, which is supplemented occasionally by water from the Zone 7 Flood Control and Water Conservation District. Sandia's sanitary sewer effluent merges with the Lawrence Livermore National Laboratory (LLNL) sewer system, and the combined waste stream discharges to the City of Livermore sanitary sewer system at the northwest corner of the LLNL site. The sanitary sewer effluent from the SNL/California site (and from the rest of the Livermore area) is processed at the Livermore Water Reclamation Plant. After treatment, the wastewater is transported via pipeline to the San Francisco Bay. A portion of the treated effluent is reclaimed and used for local irrigation.

Laboratory Setting

SNL/California is located next to the City of Livermore (population approximately 60,000), in eastern Alameda County, 65 km (40 miles) east of San Francisco (see Fig. 2-3). The operating area is surrounded on all sides by DOE-owned land, which serves as a buffer zone. The site lies at the western base of the Altamont Hills. To the north is LLNL, and further north is an expanding business park and commercial development. The property to the south and east of the site comprises agricultural and low-density residential

areas. Although principally residential, the area to the west encompasses a wide range of uses, to include a business park, grazing lands, vineyards, and other small agricultural and industrial developments.

Topography

The Livermore Valley is an irregularly shaped lowland in the Diablo Range of the California Coastal Mountain Range. The valley is approximately 26 km (16 miles) long (east to west) and averages about 11 km (7 miles) wide. The valley floor slopes gently downward to the west at about 10 m/km (50 ft/mile). The elevation is approximately 200 m (660 ft) at the eastern boundary of the valley and 90 m (295 ft) at the southwest corner.

The topography of the California site is generally characterized by relatively flat areas at the northern portion of the site,

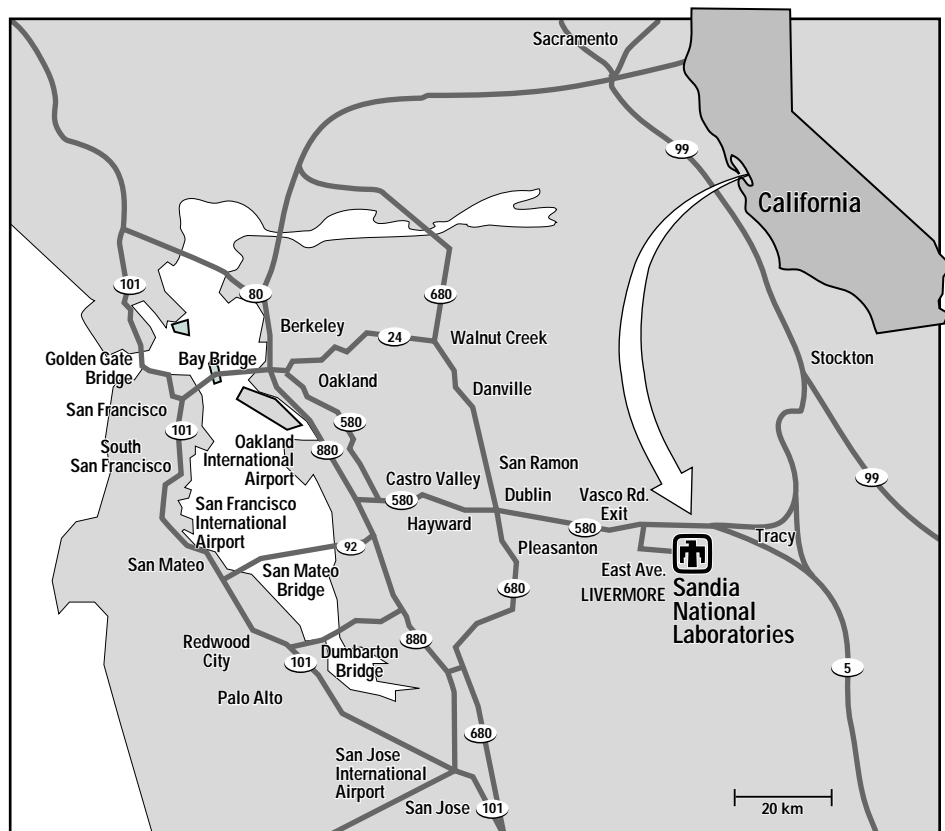


Figure 2-3. SNL/California in a regional setting.

Introduction

hills to the south, and steep banks along the Arroyo Seco.

Geology and Hydrology

The Livermore Valley overlies a complex geologic region where ancient arroyos have deposited a heterogeneous mixture of sand, silt, clay, and gravel. These alluvial deposits create layers of higher and lower permeability overlying the older Livermore formation.

The groundwater of the Livermore Valley can be found in the more permeable layers, which lie between 5 and 33 m (17 and 110 ft) below the surface (Fig. 2-4). Groundwater in the Livermore Valley

generally flows in a westerly direction.

The groundwater movement underlying the SNL/California site is strongly influenced by the Las Positas Fault Zone.

North of the fault, movement is generally westerly. South of the fault, the movement is less distinct, but appears to be radial from a groundwater mound.

Located in west-central California, the site is in a seismic region. The major faults are San Andreas, Hayward, Calaveras, and Greenville. The closest major faults are Calaveras—about 11 miles west of the site, and Greenville—about 2 miles east of the site. A small, locally active fault, the Las Positas Fault, runs through the southern portion of the site.

Intermittent streams (arroyos) flowing north-west carry surface drainage into the Alameda Creek near Sunol, which continues west to the San Francisco Bay. The Arroyo Seco crosses the site from the south-east to the northwest. Storm water runoff from the hills to the southeast flows into the arroyo during the rainy season. The arroyo is dry the rest of the year. The SNL/California site storm sewer system also channels storm water into the Arroyo Seco. This system is the main pathway for the site's surface drainage.

Climate and Meteorology

The climate of the Livermore Valley consists of mild, rainy winters and warm, dry summers. The mean annual temperature is 12.5°C (55°F),

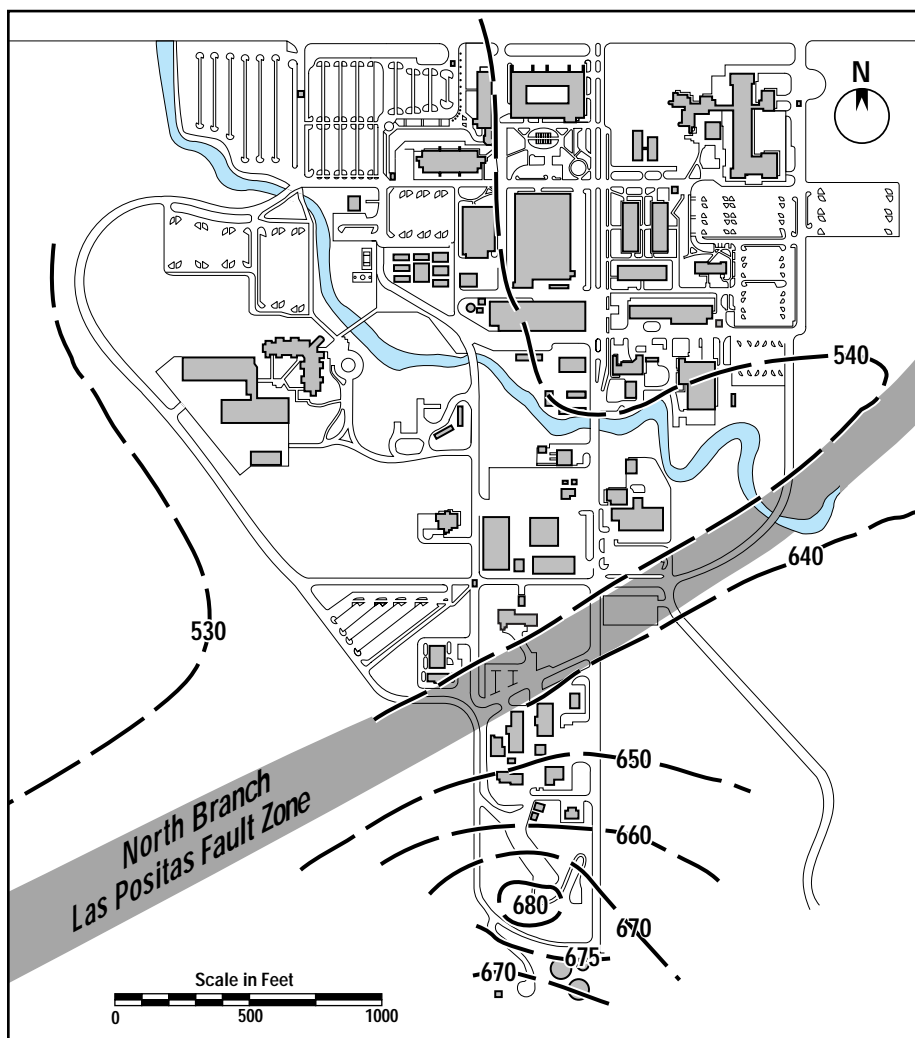


Figure 2-4. Typical groundwater contours at SNL/California.

with extremes ranging from 0° to 38°C (32° to 100°F). Rain falls primarily between October and April. Precipitation at the SNL/California site for calendar year 1998 was 52.20 cm (20.55 in.). The prevailing winds blow from the west and southwest from April to September. The winds are variable during the rest of the year.

Biological Resources

Vegetation on the developed areas of the site consists of plants suitable for general landscaping. The undeveloped land, which mainly comprises the DOE security buffer zone, is dominated by non-native grasses, such as slender oat and ripgut brome. Much of this zone is under cultivation to provide erosion control and fire protection.

The Arroyo Seco supports diverse vegetation. There are several large sycamore, valley oak, and red willow trees, as well as patches of cattail and rush at the eastern and western areas of the arroyo. The central portion of the arroyo hosts a few canyon live oak and almond trees, and annual grasses.

Biological resource surveys were conducted during June and July 1998 to identify wetlands, sensitive plant and animal species, and habitat for sensitive species that are present at the SNL/California site. Three wetland areas were identified onsite during the surveys, all within the

streambed of the Arroyo Seco (see figure 2-5).

In addition to wetlands, the SNL/California site contains suitable habitat in the western buffer area for two sensitive species, the California tiger salamander and the burrowing owl. A third sensitive species, the loggerhead shrike, was observed throughout the site and is likely to nest along the Arroyo Seco and in the scrubby habitat near the Navy landfill. Although considered sensitive, these three species are not listed as threatened or endangered.

Annual Site Environmental Report

This *Site Environmental Report* documents all SNL/California's significant environmental activities throughout the year. These include effluent and environmental monitoring, environmental restoration, and environmental protection activities. This report also evaluates SNL/California's compliance with

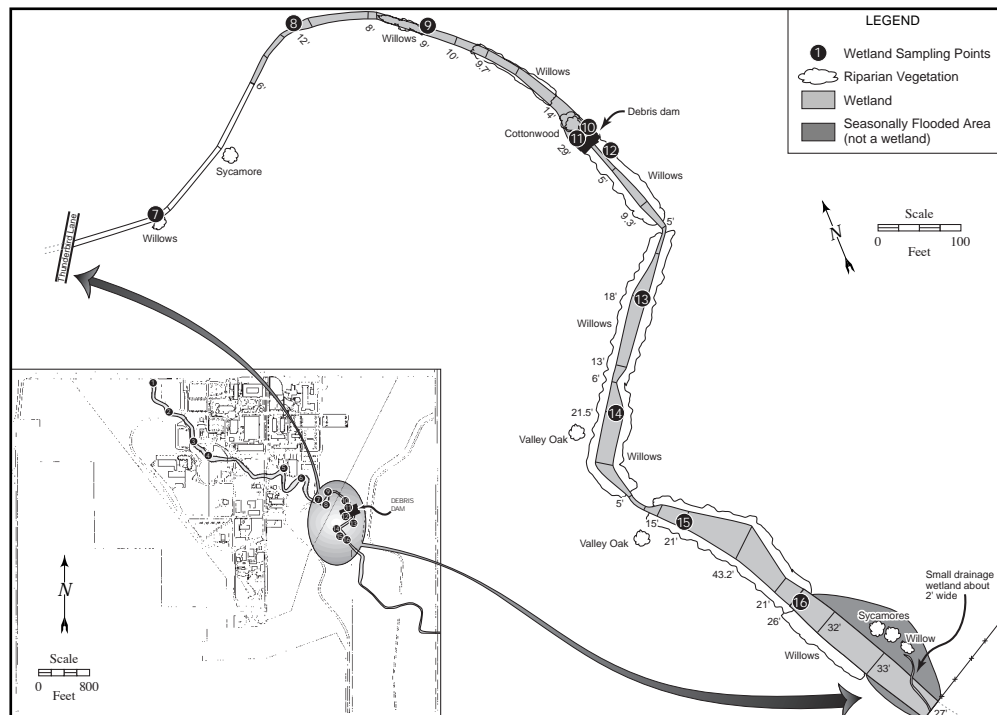


Figure 2-5. SNL/California wetland areas.

Introduction

applicable environmental requirements. It is prepared according to the requirements of DOE Order 5400.1.¹

An extensive glossary at the end of this report defines commonly used acronyms and abbreviations, as well as other technical terms used in the body of the report. The International System of Units (SI) or metric system of measurements has been used, where feasible. A section on "Units of Measure" is included in the glossary as additional information about the system of units and quantities.

Appendix A contains laboratory procedures.



References

1. U.S. DOE, Order 5400.1, *General Environmental Protection Program* (November, 1988, Change 1, June 29, 1990).

3 — Compliance Summary



Environmental Monitoring
Other Issues and Actions
Environmental Permits
Streambed Alteration Agreement

In accordance with DOE policy, SNL complies with all applicable Federal, State, and local environmental laws and requirements. In addition to meeting specific limits, SNL is obligated to keep emissions to the environment as low as reasonably achievable (ALARA).

Several Federal, State, and local government agencies are responsible for enforcing and overseeing environmental regulations at SNL/California. The principal agencies include the U.S. EPA, the Cal/EPA, the Department of Health Services, the Department of Toxic Substances Control, the San Francisco Bay Regional Water Quality Control Board, the Bay Area Air Quality Management District, and the City of Livermore Water Reclamation Plant.

Table 3-1 summarizes the major Federal environmental statutes that apply to SNL/California operations. State and local authorities also impose a variety of environmental regulations.

This chapter summarizes SNL/California's environmental management performance and documents the site's compliance with these environmental statutes and regulations in 1998. It also discusses current environmental management programs. The compliance activities at SNL/California are administered by the Environmental Operations Department.

Environmental Monitoring

The Environmental Operations Department at SNL/California maintains an environmental surveillance program to verify the effectiveness of emission control procedures and to measure directly any effects on the environment. Sampling includes a network of environmental dosimeters used to measure external radiation levels. The environmental surveillance data collected during 1998 demonstrate compliance with EPA and DOE standards.

The environmental monitoring data collected in 1998 demonstrate that opera-

tions at SNL/California had no harmful effects on the environment or the public. SNL/California's emissions to the atmosphere during the year complied with all applicable Federal, State, and local environmental laws and standards.

Environmental Programs Status

Table 3-1 briefly summarizes the major Federal environmental regulations that apply to SNL/California. They are described in detail below. Also discussed are activities related to compliance with California State regulations.

Resource Conservation and Recovery Act and California's Hazardous Waste Control Law

During 1998, SNL/California's waste programs complied with all DOE Orders and Federal and State Regulations. Hazardous waste management activities at SNL/California include handling, packaging, storing, and shipping energetic, radioactive, mixed, and nonradioactive hazardous waste for offsite shipment. All SNL/California wastes are shipped offsite for treatment, storage, or disposal. No wastes are disposed at the SNL/California site premises.

Treatment performed onsite consists of: waste compaction to reduce volume, elementary neutralization, and consolidation/commingling of various low-volume waste streams at the Hazardous Waste Storage Facility for offsite shipment.

SNL/California does not generate transuranic or high-level radioactive wastes. Except for liquids generated from scintillation counting (which have been sent offsite for incineration), mixed waste has previously been shipped to SNL/New Mexico for management. Any future mixed waste will be sent offsite for treatment and disposal.

SNL/California has an active Waste Minimization and Pollution Prevention

Compliance Summary

Awareness Program, independent from the waste management group.

Chemical Waste Program

SNL/California holds a Cal/EPA Part B permit for the Hazardous Waste Storage Facility operations. It is effective from January 4, 1993, to January 4, 2003. The permit allows SNL/California to store hazardous waste and to conduct limited treatment activities.

Low-Level Radioactive Waste Program

The low-level radioactive waste management activities at SNL/California include collecting encapsulation of some low-level radioactive waste streams, packaging, and storing radioactive waste.

The majority of low-level waste management efforts in 1998 involved preparing for shipment of low-level radioactive waste to the Nevada Test Site. Much of the waste generated this year was the result of a joint research and development project with Lawrence Livermore National Laboratory. Various types of uranium contaminated waste was generated and disposed of at the Nevada Test Site.

The DOE Nevada Operations Office audited the SNL/California low-level radioactive waste management program in February 1998. Based on the results of this review, SNL/California was granted provisional approval to continue to ship low-level radioactive waste streams to the Nevada Test Site. Approximately 4.5 m³ of waste was shipped to the Nevada Test Site in July 1998.

Mixed Waste Program

SNL management decided to consolidate all cost, liability, and management activities associated with the management of mixed waste at the SNL/New Mexico facility. SNL/California has previously transferred all mixed waste generated onsite to the SNL/New Mexico site, with the exception of liquid, scintillation-counting wastes, which have been shipped to a treatment facility (mixed

waste generated averages less than 0.4 m³ per year). In 1998, 0.9m³ of mixed waste was transferred to SNL/NM for treatment and final disposal

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is Federal legislation. It establishes a program for cleaning up contaminated areas in the environment. Two SNL/California restoration sites are affected by the Act: the Fuel Oil Spill and the Navy Landfill. SNL/California is cleaning up or assessing these sites under the authority of the San Francisco Bay Regional Water Quality Control Board. This activity is funded by the DOE Environmental Restoration Program. Assessment and remediation activities are formally regulated under RCRA and are being done under State direction.

Pursuant to San Francisco Bay Regional Water Quality Control Board Orders 88-142 and 89-184^{1,2} SNL/California was involved in two assessments during 1998: the Fuel Oil Spill, and the Navy Landfill. These are described in section 5.

Superfund Amendments and Reauthorization Act Title III; Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA)—also known as the Superfund Amendments and Reauthorization Act (SARA) of 1986, Title III—requires reporting of toxic chemical usage and releases. The purpose of this provision is to make information about potential environmental releases of toxic chemicals available to the public. In accordance with the requirements of the Act, SNL/California submits reports annually to the EPA, the State of California, and the LLNL Fire Department.

In 1998, SNL/California had two substances that were reportable under Sections 311 and 312: No. 2 fuel oil (fire hazard) and liquid nitrogen (asphyxiator, compressed gas, and cryogenic).

In 1998, SNL/California had no chemical release incidents that required notification under Sections 304 and no reportable substances under Section 313, Toxic Release Inventory (TRI). A plot of the "top five," or five most-used EPCRA 313 listed chemicals at SNL/California, is shown in Figure 3-1. This figure illustrates that SNL/California operations use far less than the 10,000 pound reporting threshold and represent a very minor Toxic Release Inventory source.

Hazardous Materials Release Response Plans and Inventory Law

The Hazardous Materials Release Response Plans and Inventory Law (California Law AB2185) covers the management of hazardous and acutely hazardous materials in the State of California. Additional state laws—AB2187, AB3777, AB3205 AB2189—and other bills modifying the state hazardous materials program are codified in the California Health and Safety Code Division 20, Chapter 6.95 §25500, et seq. SNL/California annually reviews and submits a California

Hazardous Material Management Plan in accordance with the Hazardous Materials Release Response Plans and Inventory Law (and modifying laws) to the Alameda County Environmental Health Department, Hazardous Material Program.

SNL/California also submitted an Acutely Hazardous Materials Registration Form

HM 3777 as required by the California Health and Safety Code Division 20, Chapter 6.95 §25533 and §25536.

In 1998, SNL/California had only one reportable acutely hazardous material, sulfuric acid. This determination was based on the reporting threshold of 500 pounds.

Clean Water Act/Safe Drinking Water Act

Wastewater Discharge

SNL/California maintains one Wastewater Discharge Permit issued by the City of Livermore. This permit regulates SNL/California's sanitary and industrial effluent, which is discharged to the City's sewer system, and enforces the requirements of the Federal Clean Water Act.

In 1998, all sanitary sewer effluent from the SNL/California site complied with the site outfall discharge limits for regulated physical parameters, radionuclides, and EPA priority organic pollutants. On two occasions, the sanitary sewer effluent slightly exceeded the site's discharge limits for metals.

Wastewater samples collected at the site outfall on March 21, 1998, and March 28, 1998 showed a copper concentration

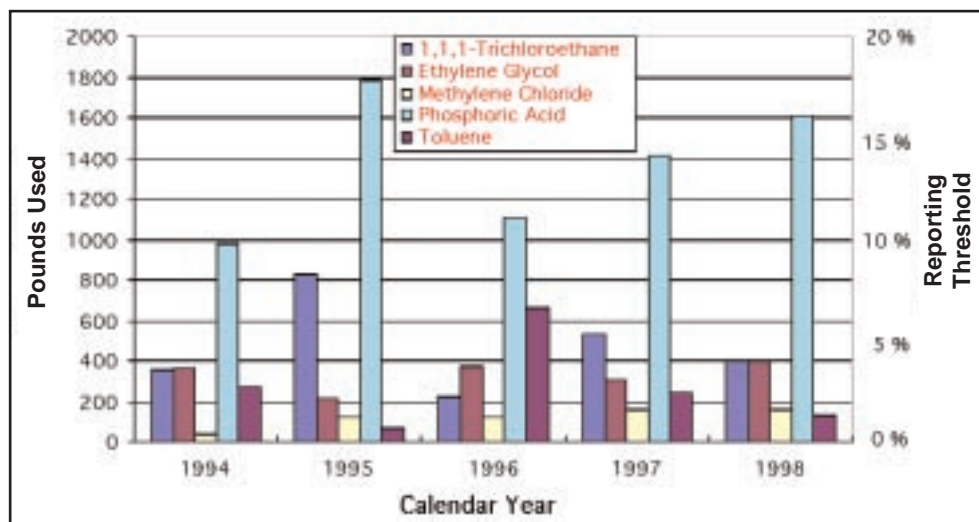


Figure 3-1. SNL/California EPCRA 313 "top five" chemicals.

Compliance Summary

of 3.1 mg/L and 2.5 mg/L respectively. The discharge limit for copper is 1.0 mg/L. The concentration of copper in the site sewer effluent on these dates was greater than the discharge limit. SNL/California notified the Livermore Water Reclamation Plant, as required by the Wastewater Discharge Permit. However, the plant staff indicated that this concentration did not adversely affect plant operations.

SNL/California notified the Livermore Water Reclamation Plant, as required by the Wastewater Discharge Permit. However, the plant staff indicated that this concentration did not adversely affect plant operations.

Details of all the wastewater monitoring and a summary of the sampling results are provided in the Sewer Outfall Monitoring section of Chapter 4, "Environmental Monitoring Program."

SNL/California operates one metal finishing categorical process subject to the EPA's pretreatment standards for point sources (Title 40 CFR, parts 403 and 433).^{6,7} This process is the Printed Wiring Facility located in Building 910. The Printed Wiring Facility requires specific sampling of the wastewater it generates.

In 1998, all the liquid effluents from the Printed Wiring Facility process complied with pretreatment discharge standards (for metals and organic pollutants).

National Pollutant Discharge Elimination System Storm Water General Permit for Industrial Activities

SNL/California is covered under the California Industrial Activities Storm Water National Pollutant Discharge Elimination System (NPDES) General Permit.⁸ This permit allows SNL/California to comply with Federal permitting requirements for storm water discharges associated with industrial activities.

The permit also requires SNL/California to implement a comprehensive storm water management program. SNL/California's program is

designed to identify and eliminate non-storm water discharges to the storm drain system, implement a storm water pollution prevention plan, and establish a storm water monitoring plan. Although the State Water Resources Control Board administers the storm water general permit, the San Francisco Bay Regional Water Quality Control Board (Regional Board) enforces the general permit in Alameda County.

In response to Federal Clean Water Act permitting requirements for municipal storm water discharges, the City of Livermore and Alameda County Flood Control & Water Conservation District (Flood Control District) have adopted ordinances that control storm water discharges to the municipal storm drain system. However, under a Memorandum of Understanding with the Regional Board, the Regional Board is the lead regulatory agency for federal facilities such as SNL/California.

SNL/California's program ensures compliance with both the general permit and local agency stormwater ordinances by implementing a *Storm Water Pollution Prevention and Monitoring Plan*⁹ that strives to eliminate non-stormwater discharges to the storm drains and minimizes the discharge of pollutants with storm water by implementing best management practices.

Drinking Water

The drinking water for the SNL/California site is supplied by the San Francisco Water District through the Hetch Hetchy Aqueduct. The San Francisco Water District is responsible for monitoring the quality of the incoming water.

SNL/California neither treats nor samples the drinking water. LLNL maintains the drinking water distribution system for both sites. Maintenance includes water quality screening analyses.

Clean Air Act/Air Quality Regulations

In 1998, SNL/California complied with applicable laws, regulations, and guide-

lines governing radiological and nonradiological emissions to the atmosphere.

Numerous operations at SNL/California are subject to the rules and regulations administered by the Bay Area Air Quality Management District (BAAQMD) because they emit, or have the potential to emit, air contaminants.¹⁰ The BAAQMD and the California Air Resources Board are responsible for promulgating regulations and providing guidance to attain and maintain EPA and State of California air quality standards.

In 1998, SNL/California complied with all the conditions specified in its operating permits. Therefore, it received no violations for air emission exceedances.

Tables 3-2 and 3-3 list the type and number of permitted sources and exemptions granted to SNL/California.

NESHAPs Compliance for Radionuclides

The EPA regulates airborne emissions of radionuclides through the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs).¹¹ On December 15, 1989, the EPA revised its NESHAPs Rule for Radionuclides—Title 40 CFR, Part 61 (Subpart H applies to DOE facilities). It establishes radiation protection standards for protection of the public, monitoring requirements, and annual reporting of radionuclide air emissions. The EPA has established 10 mrem/yr as the allowable limit of radiation dose received by the public from air emissions. SNL/California is no longer required to perform emissions monitoring, or to perform annual dose calculations based on stack emissions. SNL/California performs dose calculations for individual projects with the potential to release radionuclides to the atmosphere.

No projects evaluated during 1998 had the potential to cause doses to the public at or near the EPA limits.

National Environmental Policy Act Compliance

The National Environmental Policy Act (NEPA) is the basic national charter for the protection of the environment. NEPA requires all Federal agencies to consider issues associated with the physical and human environment in the review of proposed Federal actions. Because Sandia is a Federal government (DOE) contractor and receives Federal funds, proposed projects, programs, and activities must be evaluated by the DOE for their potential environmental effects. The DOE has issued procedures for use in complying with NEPA. SNL/California provides assistance to the DOE in meeting their NEPA requirements. SNL/California works directly with the DOE Kirtland Area Office to provide this assistance.

During 1998, 119 SNL/California projects were evaluated, and NEPA classifications and/or determinations made. Chapter 5, "Environmental Program Information," provides more information about SNL/California's NEPA activities in 1998.

Environmental Impact Statement

A site-wide Environmental Impact Statement (EIS) was issued for the SNL/California site in August 1992 (*Final Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore*). At least every five years, DOE is required to evaluate the EIS and determine if a supplement analysis is required. In 1997-1998, DOE conducted this evaluation and determined that a supplement analysis is not needed and that the EIS remains adequate in its description of activities and impacts within NEPA.

The Environmental Impact Statement (EIS) developed for SNL/California and LLNL contains a description of effluent monitoring at the two sites. Although no specific monitoring commitments are made in the EIS, the SNL/California efflu-

Compliance Summary

ent monitoring and environmental surveillance programs are accurately reflected by the description in the EIS.

Other Environmental Statutes

In 1998, SNL/California had no significant activities governed by the following regulations:

- Toxic Substances Control Act,
- Federal Insecticide, Fungicide, and Rodenticide Act,
- Endangered Species Act,
- National Historic Preservation Act,
- Floodplain Management (Executive Order 11988), or
- Protection of Wetlands (Executive Order 11990).

SNL/California maintains compliance with the regulations listed above through internally generated procedures and review of DOE orders. No lawsuits pertaining to any environmental regulation are on file against SNL/California.

Other Issues and Actions

Audits and Inspections

Operations at SNL/California are routinely subjected to internal inspections as part of a self-assessment program. In addition to this internal scrutiny, external regulatory agencies audited or inspected SNL/California in 1998. Table 3-4 lists these audits and inspections by date. The table also cites the purpose and the regulatory agency performing the inspection or audit.

Occurrence Reports

DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*,¹² requires that occurrences be consistently reported to assure that both the DOE and SNL management are kept informed of all events that could:

- affect the health and safety of the public;
- seriously impact the intended purpose of DOE facilities;
- have a noticeable adverse effect on

the environment; or

- endanger the health or safety of workers.

The SNL/California Occurrence Reporting System has established a formal process for investigating and notifying the DOE of unusual events at the site. The goals of SNL/California's Occurrence Reporting System are to ensure the following:

- timely identification, categorization, notification, and reporting to SNL and DOE management;
- timely evaluation and implementation of corrective actions, including root cause analyses to identify appropriate corrective actions; and
- dissemination of lessons learned to prevent occurrence of similar events.

Table 3-5 lists all the environment-related events reported through Sandia's Occurrence Reporting System in 1998. The system provides background information for each event reported, including date, type of occurrence, and a brief description.

Environmental Permits

Table 3-6 identifies the environmental permits held by SNL/California in 1998 and the regulatory agencies responsible for enforcing the respective regulations and permit conditions.

Hazardous Waste Permits

The Cal/EPA issued a final RCRA "Part B" permit on December 4, 1992, for SNL/California to operate the Hazardous Waste Storage Facility. The permit is effective from January 4, 1993, to January 4, 2003.

As provided by the 1984 Hazardous and Solid Waste Amendments to RCRA, the Cal/EPA conducted a RCRA Facility Assessment in April 1991. The assessment report was issued in September 1991. The Cal/EPA revised this report and reissued it in March 1992.¹³ It identified three "solid waste management units" at SNL/California: the Fuel Oil Spill, the

Navy Landfill, and Miscellaneous Sites. However, because these units were being assessed and remediated as part of the San Francisco Bay Regional Water Quality Control Board Order, no corrective action was required.

All waste handling operations at SNL/California are conducted according to the most recent State and Federal regulations. More information on SNL/California's Hazardous Waste Program is provided in Chapter 5, "Environmental Program Information."

Air Quality Permits

The BAAQMD Operating permits are renewed annually. In 1998, SNL/California had BAAQMD permits for 24 sources of air pollutants, such as boilers, vapor degreasers, a paint spray booth, and various abatement devices (see Table 3-2). SNL/California also operated 30 exempt sources, such as, explosives test cell/facilities, abrasive blasters, plating operations, and Research and Development laboratories (see Table 3-3).

Wastewater Discharge Permit

SNL/California holds one Wastewater Discharge Permit issued by the Livermore Water Reclamation Plant. This permit regulates SNL/California's sanitary and industrial liquid effluent, which is discharged into the City's sewer system. It is renewed annually. It contains discharge limits for the site sanitary sewer outfall and for processes subject to EPA pretreatment standards. The permit also contains liquid effluent monitoring and reporting requirements. For more details, see Chapter 4, "Environmental Monitoring Program," which has a summary of the conditions of SNL/California's Wastewater Discharge Permit.

Groundwater Discharge Permit

SNL/California holds one Groundwater Discharge Permit issued by the Livermore Water Reclamation Plant. This permit

regulates the discharge to the sanitary sewer system of water captured by the aquifer protection wells at the Fuel Oil Spill site. SNL/California treats the water before discharging it to the sanitary sewer system. The permit is renewed every two years. It contains discharge limits and monitoring and reporting requirements for the chemical constituents of concern. For more details, see Chapter 4, "Environmental Monitoring Program," which has a summary of the conditions of SNL/California's Groundwater Discharge Permit.

National Pollutant Discharge Elimination System Storm Water General Permit for Industrial Activities

SNL/California is covered under the California Industrial Activities Storm Water National Pollutant Discharge Elimination System (NPDES) General Permit.⁸ This permit allows SNL/California to comply with Federal permitting requirements for storm water discharges associated with industrial activities.

The permit also requires SNL/California to implement a comprehensive storm water management program. Sandia's program is designed to identify and eliminate non-storm water discharges to the storm drain system, implement a storm water pollution prevention plan, and establish a storm water monitoring plan. Although the State Water Resources Control Board administers the storm water general permit, the San Francisco Bay Regional Water Quality Control Board enforces the general permit in Alameda County, for facilities such as SNL/California.

In response to Federal Clean Water Act permitting requirements for municipal storm water discharges, the City of Livermore has adopted ordinances that control storm water discharges to the City's storm drain system. The Livermore Water Reclamation Plant enforces the

Compliance Summary

City's storm water management ordinance.

Streambed Alteration Agreement

SNL/California has a Streambed Alteration Agreement with the California Department of Fish and Game to conduct maintenance activities in the Arroyo Seco. The Streambed Alteration Agreement allows Maintenance personnel to remove debris that accumulates in the Arroyo using hand held equipment only. These activities are necessary to reduce the potential for flooding during rain events. The authorization is valid for three years.

State Water Resources Control Board (September 17, 1992).

9. EOA, Inc., Storm Water Pollution Prevention and Monitoring Plan, for Sandia National Laboratories/California (January 1994).

10. State of California, Bay Area Air Quality Management District, *Rules and Regulations* (issued January 1980; as revised).

11. U.S. EPA, Title 40 CFR, Part 61, NESHAPs (December 15, 1989).

12. U.S. DOE, O 232.1, Occurrence Reporting and Processing of Operations Information (July 21, 1997).

13. State of California, Environmental Protection Agency, RCRA *Facility Assessment Report* (March 1992).

References

1. State of California, San Francisco Bay Regional Water Quality Control Board, Order 88-142 (September 21, 1988).
2. State of California, San Francisco Bay Regional Water Quality Control Board, Order 89-184 (December 13, 1989).
3. U.S. DOE, Sandia National Laboratories/California, *Solid Waste Water Quality Assessment Test Report* (March 1990).
4. U.S. DOE, Sandia National Laboratories/California, *Final Additional Field Investigation Report* (March 1994).
5. State of California, San Francisco Bay Regional Water Quality Control Board, Recommendation for Closure (November 1994).
6. U.S. EPA, Title 40 CFR, Part 403, *Federal Wastewater Pretreatment Standards* (July 1994).
7. U.S. EPA, Title 40 CFR, Part 433, *Metal Finishing Point Source Category* (July 1994).
8. State of California, "NPDES General Permit for Storm Water Discharge Associated with Industrial Activities,"

Compliance Summary

Table 3-1. Major Federal Environmental Regulations Applicable to SNL/California.

Legislation	Description
Resource Conservation and Recovery Act (RCRA)	RCRA regulates hazardous, nonhazardous, and medical waste. It also regulates underground storage tanks containing hazardous substances and petroleum products.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Superfund Amendments and Reauthorization Act (SARA)	CERCLA and SARA establish liability, compensation, cleanup, and emergency response for hazardous substances released to the environment.
Emergency Planning and Community Right-to-Know Act (EPCRA)	EPCRA (SARA Title III) requires that hazardous substances used on site be reported to State and local governments and to the general public.
Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES)	Through the NPDES, the CWA regulates liquid discharges for both wastewater and storm water discharges from industrial activities.
Clean Air Act (CAA) National Emission Standards for Hazardous Air Pollutants (NESHAPs)	The CAA and NESHAPs set air quality standards for hazardous air emissions, such as radionuclides and benzene.
Toxic Substances Control Act (TSCA)	The TSCA controls the use and exposure of new industrial chemicals. It also regulates the use and disposal of polychlorinated biphenyls (PCBs).
National Environmental Policy Act (NEPA)	NEPA establishes criteria for evaluating potential environmental impacts of Federal activities and alternatives.

Compliance Summary

Table 3-2. SNL/California Bay Area Quality Management District Permitted Sources.

Source Type	Number of Permits Held
Boilers	12
Degreasers/cleaners	3
Paint spray booth	1
Gasoline dispensing facility	1
Miscellaneous	7
Total	24

Table 3-3. Bay Area Quality Management District Exemptions Held by SNL/California in 1998.

Source Type	Number of Exemptions Held
Research and Development Laboratories	14
Diesel fuel dispensing tanks	2
Explosive test cells	3
Abrasive blasters	2
Miscellaneous	9
Total	30

Table 3-4. Environmental Audits and Inspections of SNL/California in 1998.

Date	Regulatory Authority	Purpose
1/98	California Highway Patrol	Vehicle inspection (hazardous waste)
2/98	DOE/Nevada Operations Office	Low-level radioactive waste
2/98	Nevada Test Site	Low-level radioactive waste tabletop audit
5/98	CA/DTSC	Audit of Waste Management Programs
5/98–9/98	Bay Area Air Quality Management District	Inspection of permitted and exempted air pollution sources
12/9–10/98	City of Livermore Water Reclamation Plant	Wastewater inspection

Compliance Summary

Table 3-5. Environment-related Occurrence Reports During 1998.

Report No.	Date	Subject	Occurrence Category	Description of Occurrence
ALO-KO-SNL-CASITE-1998-0005	4/23/98	Exceedance of wastewater discharge permit No. 1251	Off-normal	The April 14, 1998 laboratory results from the SNL/California sanitary sewer outfall monitoring system showed copper concentrations of 3.1 and 2.5 mg/L for the 3/21/98 and 3/28/98 daily samples. These two exceedances are connected because they occurred a week apart, and involved the same constituent (copper).

Table 3-6. SNL/California Environmental Permits in 1998.

Category	Regulation/Authority	Permit Status
Waste Management	Title 40 CFR 264 (RCRA), EPA; Title 22 CCR, Division 4.5, Cal/EPA	Part B permit effective until January 4, 2003.
Air Quality	Bay Area Air Quality Management District	Bay Area Air Quality Management District Permit-to-Operate for 54 emission sources. Permit renewed annually. (See Tables 3-2 and 3-3).
Wastewater Discharge	City Ordinance, City of Livermore	Permit for the site sanitary and industrial wastewater discharge. Permit renewed annually.
Storm Water Discharge	Clean Water Act (Title 40 CFR 122-124), EPA National Pollutant Discharge Elimination System, State Water Resources Control Board	SNL/California has a Notice of Intent on file with the State Water Resources Control Board. As a result, Sandia is covered by the State's National Pollutant Elimination System, General Permit for Discharge of Storm Water Associated with Industrial Activities. Permit renewed every 5 years.
Groundwater Discharge	City Ordinance, City of Livermore	Permit for discharging treated groundwater to the sanitary sewer. Permit renewed every 2 years.
Streambed Alteration Agreement	Sections 1601-1606 of the Fish and Game Code/California Department of Fish and Game	Authorization to remove debris with hand-held equipment only. Effective until October 2000.

4 – Environmental Monitoring Program



Effluent Monitoring Results
Environmental Surveillance Results
Environmental Impacts

Environmental Monitoring Program

The Environmental Operations Department at SNL/California (in conjunction with LLNL) maintains effluent monitoring and environmental surveillance programs. The purpose of these programs is to assess and control potential impacts, if any, to the public and the environment from operations at SNL/California. The department monitors all significant effluents, making sure SNL/California continually complies with environmental protection laws and standards. Monitoring activities verify the effectiveness of emission control measures by routinely examining environmental media, such as groundwater, storm water runoff, and sewage, for radionuclides (if appropriate), and hazardous chemicals that may be emitted from site operations. An extensive environmental dosimeter network also measures external radiation levels.

SNL/California's environmental monitoring activities (jointly with LLNL) ensure that all significant exposure pathways are monitored. Table 4-1 shows the types and number of samples collected, the collection frequency, and the parameters measured.

This chapter discusses the results of SNL/California and LLNL's joint monitoring and surveillance activities. The data are interpreted and evaluated according to applicable standards.

Effluent Monitoring Results

Airborne Effluents

The Bay Area Air Quality Management District regulates air emissions of nonradiological pollutants by issuing operating permits. These permits set operating conditions or limitations on sources (equipment or operations) that may emit pollutants to the air. SNL/California has no sources that require routine emission monitoring for pollutants. SNL/California's permits are discussed further in Chapter 3.

Liquid Effluents

SNL/California's Wastewater/Storm Water Program ensures that liquid effluents generated by SNL/California operations comply with applicable regulations. Wastewater discharge limits are imposed by the DOE,¹ the City of Livermore, and other State and Federal agencies. Frequency, methods of sample collection, and parameters for which to analyze are specified in Federal regulations or by SNL/California's wastewater discharge permit. SNL/California continually strives to reduce pollutants in liquid effluents to the lowest levels possible.

In 1982, the EPA National Pretreatment Program provisions of the Clean Water Act (CWA) established liquid effluent monitoring requirements for specific pollutants.² Accordingly, SNL/California's Wastewater Control Program emphasizes controlling effluents at the source. SNL/California imposes strict administrative and engineering controls to prevent contaminated liquid discharge to the sanitary sewer system.

Wastewater from SNL/California operations is collected and analyzed before it is released to the sanitary sewer. This analysis allows SNL/California personnel to verify that contaminant levels are acceptable before they allow the water to be released to the sanitary sewer. Almost always, the contaminant concentrations are less than the discharge limits and often are less than detection limits. SNL/California is able to treat wastewater with contaminant concentrations greater than internal site limits, but less than hazardous waste limits. This capability allows SNL/California to further reduce the already low risk of contaminants entering the sanitary sewer. In addition to monitoring at the source, SNL/California extensively monitors the sanitary sewer effluent as it leaves the site (see Sewer Outfall Monitoring below).

Liquid effluent discharges are analyzed according to applicable regulations governing discharges to a publicly-owned

Environmental Monitoring Program

treatment works. These regulations include:

- **Federal Regulations**
The Clean Water Act (CWA) provides the legislative framework for protecting the nation's waterways. Liquid discharges into surface waters and municipal sewer systems from industrial sources are regulated. In accordance with the objectives of the CWA, the EPA has established categorical pretreatment standards for specified classes of industrial dischargers. SNL/California is designated as a "Metal Finishing Point Source Category." Therefore, SNL/California is subject to the pretreatment standards in Title 40 CFR, Parts 403 and 433. These standards are based on available pollution control technology for specific industrial processes.
- **State of California**
The EPA has delegated authority to the State of California to enforce the National Pollutant Discharge Elimination System (NPDES) and *Federal Categorical Pretreatment Standards* (Title 40 CFR, Part 403).² The San Francisco Bay Regional Water Quality Control Board has issued an NPDES permit to the City of Livermore Water Reclamation Plant. In addition, the Federal pretreatment program is administered through the Livermore Water Reclamation Plant (LWRP) with oversight by the San Francisco Bay Regional Water Quality Control Board. This arrangement ensures a viable pretreatment program and enforcement of all pertinent State and Federal regulations.
- **City of Livermore**
Section 13.32 of the City of Livermore Municipal Code contains the discharge limits for Livermore's sanitary sewer system. These limits are stated in Sandia's Wastewater Discharge Permit, issued annually by the Livermore Water Reclamation Plant.

In general, no facility may discharge any pollutant or wastewater that will interfere with the operation or performance of the publicly owned treatment works.

- **DOE Orders**
The principal DOE order governing discharges to public sewer systems is DOE Order 5400.5, Radiation Protection of the Public and the Environment. The purpose of this order is to establish standards and requirements for DOE operations to protect members of the public and the environment against undue risk from radiation. The DOE orders only address radiation protection, e.g., radionuclide discharges to public sewer systems.

No radionuclides are routinely discharged to the sanitary sewer from operations at the SNL/California site.

Liquid Effluent Control Systems Description

SNL/California controls at the generating source potentially contaminated liquid effluents from the major wastewater generating operations on-site. These effluents are routed to liquid effluent control systems (LECS). LECS consist of large, monitored holding tanks, which collect wastewater, allowing it to be analyzed before being released to the sanitary sewer. By retaining the wastewater at the point of generation, SNL/California can attempt to ensure it is within allowable limits before discharging it and can prevent most accidental releases to the sanitary sewer system.

LECS Locations

Figure 4-1 shows the locations of all the LECS at the SNL/California site:

- Bldg. 968—all floor drains and laboratory sinks in Bldg. 968 are routed to two 2,500-gallon tanks.
- Bldg. 913—process wastewater from the central and southern portions of Bldg. 913 and from laboratories in Bldg. 916 is routed to a LECS consist-

Environmental Monitoring Program

ing of three 5,000-gallon tanks.

- Bldg. 910—process wastewater is routed from the Printed Wiring Laboratory to a LECS consisting of one 5,000-gallon tank.
- Bldg. 961—water from decontamination operations is routed to a LECS consisting of one 2,000-gallon tank.
- Bldg. 906—process wastewater is routed to a LECS consisting of two 5,000-gallon tanks.
- Bldg. 941—process wastewater is routed to a LECS consisting of two 5,000-gallon tanks.

Methods

To assure that a representative sample is collected, the contents of the tanks are agitated by recirculation or air bubbling before they are sampled.

Analyses

To ensure compliance with the SNL/California wastewater permit requirements, a grab sample of the LECS contents is collected before the water is discharged to the sanitary sewer. A State-certified commercial laboratory analyzes the samples for parameters associated with the process generating the wastewater. The analyses typically include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. If needed, analyses for uranium and tritium may be performed by SNL/California personnel.

Federal Categorical Processes

Locations

SNL/California operates one “categorical process,”

which discharges to the municipal sanitary sewer system; the Printed Wiring Laboratory in Bldg. 910.³ This discharge is subject to the *Federal Pretreatment Standards* (Title 40 CFR, Part 433). Semiannually, SNL/California conducts special sampling procedures for this facility’s wastewater. The compliance point for categorical processes is at the end of the process, not at the site outfall. The discharge limits differ from those imposed on SNL/California’s site outfall (see below).

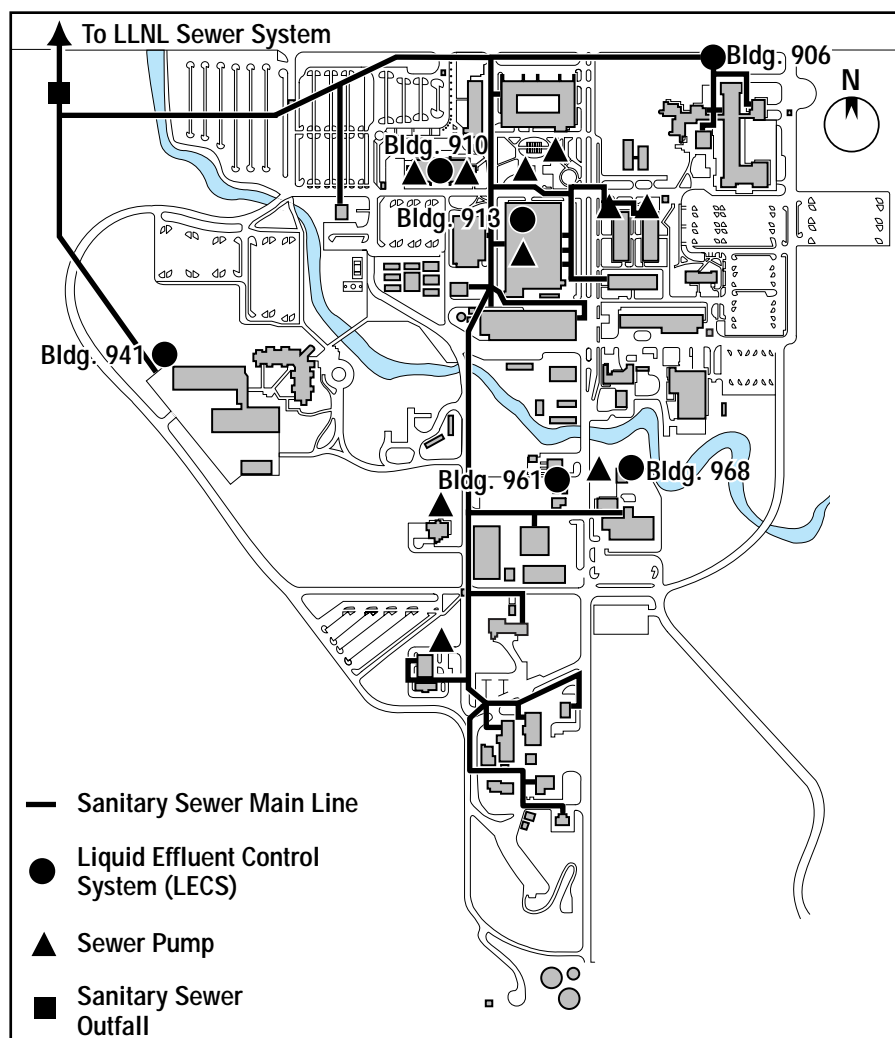


Figure 4-1. Sewer and LECS locations.

Environmental Monitoring Program

Analyses

To comply with the requirements of the Federal Pretreatment Standards, SNL/California collects grab samples of the wastewater from the Printed Wiring Laboratory semiannually. A State-certified commercial laboratory analyzes the samples for pH, arsenic, cyanide, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, and toxic organic compounds. The toxic organic compound analysis covers all EPA priority organic pollutants.

Results

The 1998 data for the semiannual monitoring showed that the wastewater met all of the pretreatment standards. The following parameters were consistently seen above their detection limits, but below their regulatory limits:

- Chromium—the regulatory limit for chromium is 1.71 mg/L. Chromium was seen at levels ranging from 0.01 to 0.28 mg/L.
- Copper—the regulatory limit for copper is 2.07 mg/L. Copper was seen at levels ranging from 0.03 to 1.6 mg/L.
- Zinc—the regulatory limit for zinc is 1.48 mg/L. Zinc was seen at levels ranging from 0.01 to 0.37 mg/L.

These data are also reported in the SNL/California *Categorical Process Report*, which is submitted to the LWRP semiannually.⁴

Groundwater Discharge to the Sanitary Sewer

Location

SNL/California operates a network of aquifer protection wells and a system of injection and withdrawal wells. The purpose of the groundwater extraction network is to capture any groundwater contaminated by the diesel fuel at the Fuel Oil Spill site. Treatment water from the *in situ* bioremediation activities is captured from the soils by the withdrawal wells and is passed through an above ground treatment system. Effluent from the treat-

ment system is discharged to the sanitary sewer system and is subject to the discharge limits and monitoring and reporting requirements of the Groundwater Discharge Permit issued by the Livermore Water Reclamation Plant.

Analyses

On January 27, 1997 the City of Livermore issued an amendment to the Groundwater Discharge permit. Previously, the Groundwater Discharge permit required samples to be analyzed for TPH-Diesel and BTEX. The amendment eliminated the sampling requirement for BTEX. Samples collected after January 1997 were analyzed for TPH-Diesel only. SNL/California's Groundwater Discharge Permit has a two-year time limit and will not need to be renewed until July 1999. To comply with the Groundwater Discharge Permit, SNL/California collects grab samples of effluent from the treatment system quarterly. A State-certified commercial laboratory analyzes the samples for total petroleum hydrocarbons as diesel.

Results

Groundwater discharge to the sanitary sewer in 1998 complied with the discharge permit requirement. All of the results were below the detection limit. The permit limit is 250 µg/L for TPH-Diesel.

Details of the Environmental Restoration Program, which the fuel oil spill site is a part of, are provided in Chapter 6, "Groundwater."

Sewer Outfall Monitoring

SNL/California monitors its sanitary sewer effluent before it exits the site and joins the sanitary sewer flow from LLNL. Monitoring is continuous and sampling comprises grab and flow-proportional daily and weekly composite sampling.

Locations

Samples are collected at the monitoring station at the site sewer outfall. Figure 4-1 shows the site's sanitary sewer system

Environmental Monitoring Program

and the location of the sanitary sewer monitoring station at the SNL/California site.

Methods

SNL/California uses real-time instruments to continuously monitor the site sewer effluent for flow and pH. Grab samples are taken from the effluent stream immediately after it reaches the real-time monitors. Flow-proportional samples are collected by two automatic, refrigerated, ISCO in-line samplers, one collecting a daily composite sample and the other a weekly composite. The daily composite sample is retained as an archive sample to use if confirmatory analyses are required.

Analyses

A flow-proportional composite sampler samples the sewer effluent so that SNL/California can monitor its compliance with the discharge limits contained in the site's Wastewater Discharge Permit. SNL/California conducts all sampling and analysis in accordance with the provisions of the permit.

SNL/California continuously monitors the liquid effluent at the site sewer outfall for pH and flow. SNL/California collects composite and grab samples and sends them to a State-certified laboratory for analysis. The certified laboratory analyzes the composite samples for regulated metals, oxygen demand, and total dissolved and suspended solids. It analyzes the grab samples for cyanide, oil and grease, and EPS priority organic pollutants (EPA Methods 608, 624 and 625).

The weekly composite sample is analyzed for metals. Monthly, a composite sample is analyzed for total dissolved solids (TDS), total suspended solids (TSS), biochemical oxygen (BOD), chemical oxygen demand (COD), and specific conductivity. A grab sample is collected monthly and is analyzed for cyanide, oil and grease and EPA priority organic pollutants (EPA Methods 624, 625, and 608). Beginning May 1998, SNL/California no longer collects samples for organochlo-

rine pesticides and PCB's (EPA Method 608). All the analytical results are tabulated in SNL/California's *Wastewater Discharge Compliance Report*, which is submitted to the Livermore Water Reclamation Plant monthly.⁵

Quality Assurance

SNL/California retains the daily composite sample as an archive sample. This archive sample is analyzed in case the weekly composite sample shows unusual concentrations of any parameter of concern. Data from the archive sample analysis are used to validate data from the weekly sample. SNL/California collects duplicate samples monthly for all parameters.

Results

In 1998, all liquid effluent from the SNL/California sanitary sewer outfall complied with the site outfall discharge limits for regulated physical parameters, radionuclides, and EPA-priority organic pollutants. On two occasions, the sanitary sewer effluent slightly exceeded the site's discharge limits for metals.

Wastewater samples collected at the site outfall on March 21, 1998 and March 28, 1998, showed a copper concentration of 3.1 mg/L and 2.5 mg/L respectively. The discharge limit for copper is 1.0 mg/L. The concentration of copper in the site sewer effluent on these dates was greater than the discharge limit.

An extensive investigation was conducted to locate the source of these two exceedences. The investigation included analysis of the SNL/California drinking water supply; analysis of various building's chilled water supply; inquiries of maintenance activities on these dates; interviews of lab owners; and finally an announcement in the electronic daily news requesting help in finding the source. Despite these efforts, the source of the copper was never located. Figure 4-2 shows weekly composite copper concentrations in the sanitary sewer for 1998.

SNL/California performed a Mann-Kendall trend test on the 1998 metals and

Environmental Monitoring Program

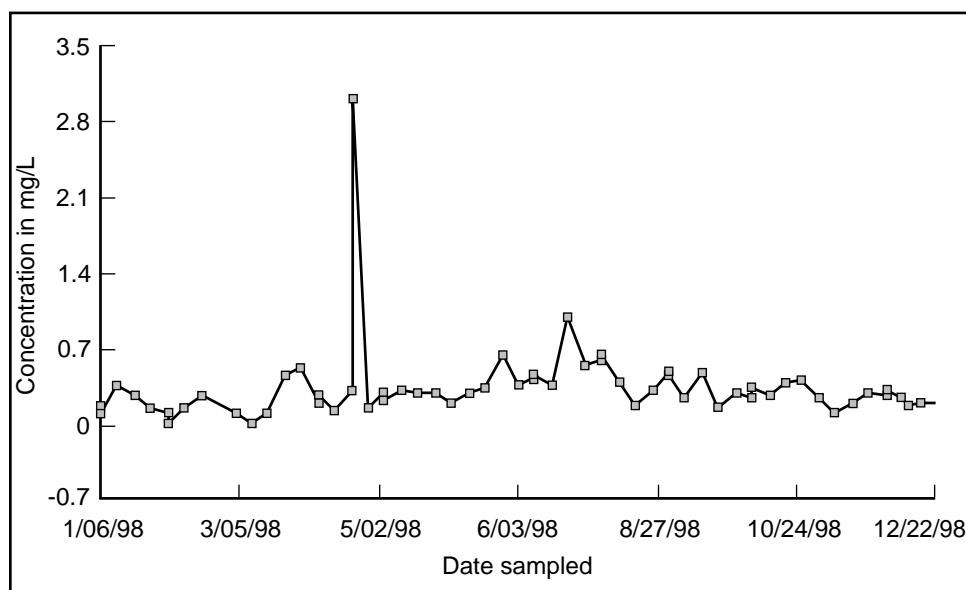


Figure 4-2. Copper concentrations in the sanitary sewer.

physical data. Biochemical oxygen demand, total dissolved solids, and specific conductance showed upward trends. When 1997 data were included in the trend analysis, total suspended solids and specific conductance showed no trend. All other parameters showed no detectable trend. These trends are not a concern because none of the parameters exceeds site discharge limits on a regular basis. SNL/California will continue to monitor trends.

Storm Water Runoff

Description

As storm water flows off buildings, material-handling areas, parking lots, and other impervious areas on-site, it may pick up various pollutants, such as oil and grease, soil, litter, pesticides, and fertilizer. During dry weather, any non-storm-water discharge eventually evaporates; however, pollutants left on the ground still may be picked up and transported by runoff in a subsequent rainstorm. The SNL/California storm drain system conveys all runoff to the Arroyo Seco, which discharges into the Alameda Creek and eventually to the San Francisco Bay.

To assess the impact of site operations to storm water discharge, SNL/California collects samples of surface runoff at various points in the site's storm drain system.

Locations

Figure 4-3 shows the storm water sampling locations at SNL/California, as follows:

- Location A—maintenance, materials handling and storage, and equipment storage on the west side of the Combustion Research Facility.
- Location B—material handling and equipment transfer for a maintenance area.
- Location C—handling of all incoming materials on site.
- Location D—material handling and storage; hazardous materials storage area; maintenance yard.
- Location F—material handling area and storage sheds.
- Location G—material handling area and storage sheds; chemical storage shed and loading dock.
- Location N—inactive Navy Landfill area now used for storing explosive materials in bunkers. This location is an upstream discharge location to the Arroyo Seco. Runoff from the old Navy Landfill area is monitored to evaluate the potential for erosion.
- Location X—maintenance and equipment storage areas in the vicinity of building 968.
- Location Y—Arroyo Seco entering the site.
- Location Z—Arroyo Seco exiting the site.

Environmental Monitoring Program

Methods

SNL/California collects samples during two storms that produce runoff sufficient to allow collection of storm water in sample bottles. The difference of the ground's permeability in different areas throughout the site often means there is surface runoff in some areas and none in other areas during the same storm event. SNL/California continues to sample until there are two samples for each location if possible; therefore, there are usually more than two storm events sampled throughout the year.

Samples are collected at points in the storm water conveyance system that best represent certain drainage areas and types of activities. Storm water samples are collected and preserved in accordance with EPA standard methods, which are described in Title 40 CFR, Part 136.⁶

In 1998, samples were collected at all 10 locations during at least two storm-sampling events except locations N and Y. Locations N and Y did not have sufficient flow to collect samples during the first storm of the 1998/1999 wet season. Stormwater sampling requirements must be met within a wet season which runs from October through May. SNL/California will collect two stormwater samples for locations N and Y during the latter part of the wet season in 1999. Automatic samplers are installed at locations D, G, Y, and Z which represent the sampling locations in the Arroyo Seco. As

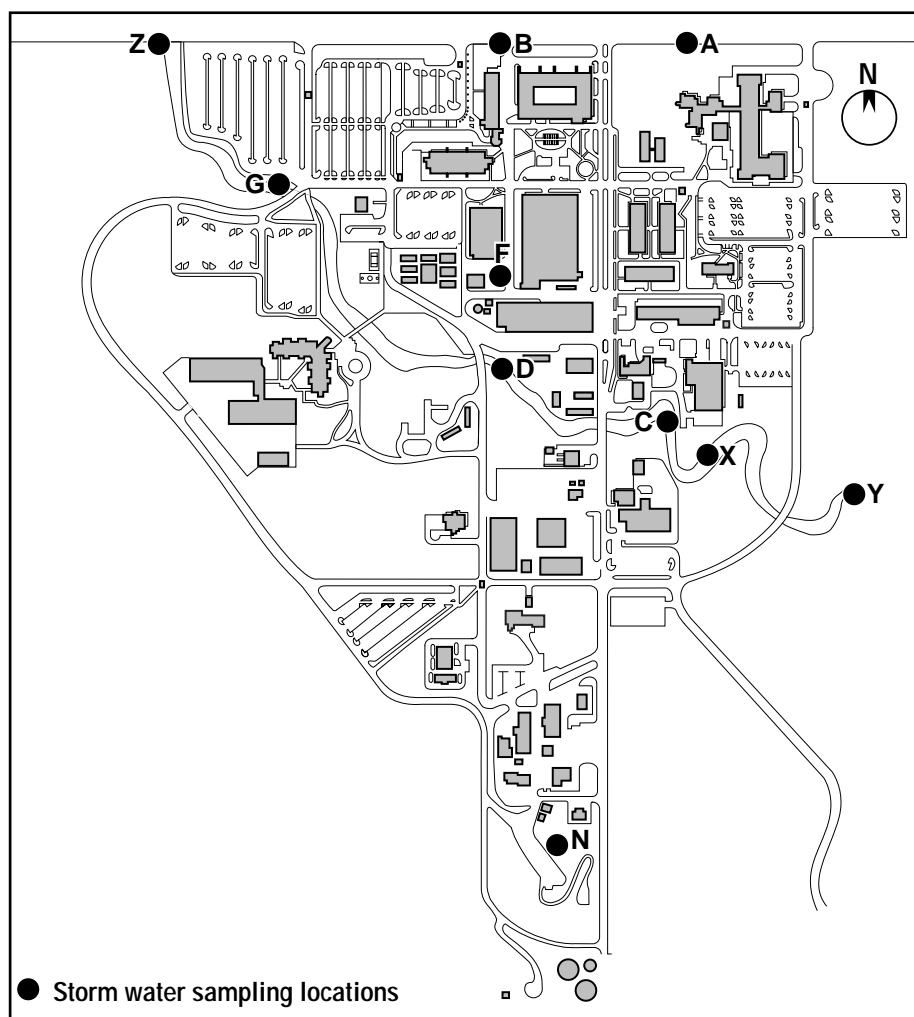


Figure 4-3. Storm water sampling locations on the SNL/California site.

slope conditions do not allow safe access to the arroyo during storm events, automatic samplers help ensure the safety of SNL/California personnel during storm water sampling.

Analyses

A State-certified laboratory analyzes storm water samples for specific conductivity, pH, total suspended solids, and oil and grease, as required by SNL/California's storm water permit requirements. Ammonia, cyanide, chemical oxygen demand, nitrate/nitrite, aluminum, iron, magnesium, and selenium were added to the SNL/California sampling suite when the general permit was

Environmental Monitoring Program

reissued in April 1997. The additional parameters are being incorporated into the 1997/98 wet season sampling. SNL/California also performed tritium analyses for baseline information.

Quality Assurance

SNL/California collects approximately 10% duplicate samples and field blank samples to assess potential contamination of storm water samples. Duplicate and blank sample collection locations are randomly chosen and vary between storms.

Results

Regulatory agencies have not established numerical effluent standards for storm water discharge. SNL/California uses sampling data to optimize storm water pollution prevention activities and to identify trends. Because the Storm Water Monitoring Program is only 5 years old, SNL/California does not have enough data at each sampling location to perform trend analyses or statistical comparisons between locations. The 1993 through 1998 data will provide a baseline, to which future samples will be compared.

SNL/California's 1998 storm water sampling results successfully identified site conditions and activities that impacted storm water quality. No pollutants were detected at levels that would be a cause for concern during 1998. A critical review of the results show the following:

- **Oil and Grease**—Oil and grease were detected at 9, 6 and 14 mg/L at locations D, X and C respectively during the November 1998 sampling event. This is the first time oil and grease has been detected above detection limit and SNL/California is reviewing pollution prevention practices in these drainage areas.
- **pH** - Sample pH ranged from 6.8 to 8.2, which is within the range of the guidance published by the State Water Resources Control Board (State Board). Figure 4-4 shows pH levels in storm water runoff.
- **Total suspended solids (TSS)**—TSS concentrations ranged from below the detection limit of 10 mg/L to 13,000 mg/L. The concentrations detected are within the range of those seen in previous years. The highest value is from location Y,

which represents background storm water as it flows onto SNL/California property; SNL/California activities have no impact on runoff collected from location Y. The highest concentration from a sampling location on site was 850 mg/L. Figure 4-5 shows concentrations of TSS in storm water.

- **Specific conductivity**—Specific conductivity measurements ranged from 16 to 2100 $\mu\text{mhos/cm}$. As with the TSS, the sample with the highest specific conductivity value was collected at location Y, which

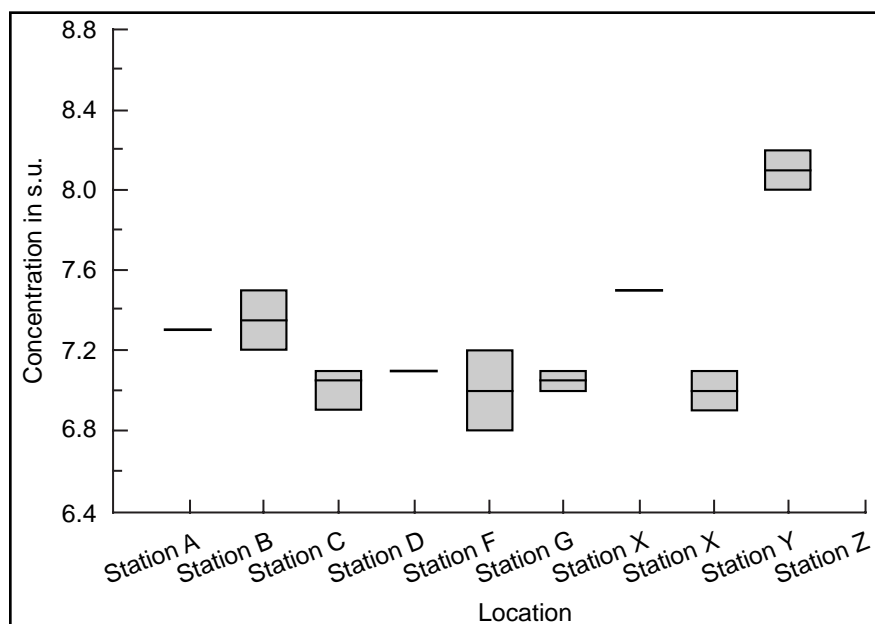


Figure 4-4. pH in storm water.

Environmental Monitoring Program

represents the storm water as it flows onto SNL/California property. The highest specific conductivity concentration from a sampling location on site was 43 $\mu\text{mhos/cm}$.

Figure 4-6 shows specific conductivity levels in storm water.

Additional parameters were added to the sampling suite when the general permit was reissued in April 1997. These parameters were incorporated beginning of 1997/98 wet season sampling. In 1998, a review of the results for the additional parameters show the following:

- **Aluminum** — Aluminum concentrations ranged from 0.36 to 93 mg/L. The sample with the highest concentration was collected at location Y which represents storm water as it flows on site. The highest concentration from a sampling location on site is 18 mg/L. Concentrations detected at Station Y are higher than those detected in 1997. On site concentrations are similar to those detected in 1997.
- **Iron** — Iron concentrations ranged from 0.27 to 110 mg/L. The sample with the highest concentration was collected at location Y which represents storm water as it flows on site. The highest concentration from a sampling location on site is 20 mg/L. The concentrations detected are within the range of those seen in 1997.

- **Nitrate and Nitrite Nitrogen** — Nitrate and nitrite nitrogen concentrations ranged from below the detection limit of 0.11 mg/L to 1.2 mg/L. The sample with the highest concentration was collected at location Y which represents storm water as it flows on site. The highest concentration from a sampling station on site is 0.34 mg/L.

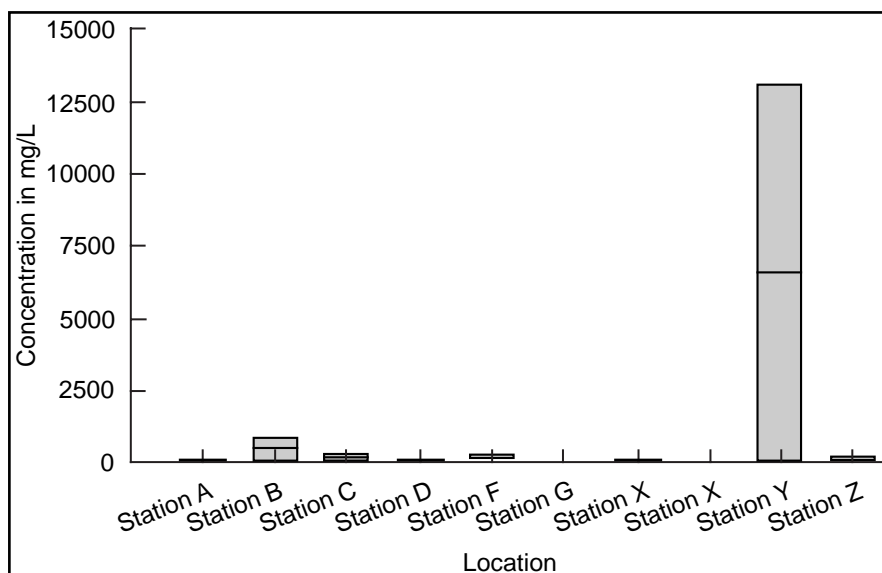


Figure 4-5. Total suspended solids in storm water.

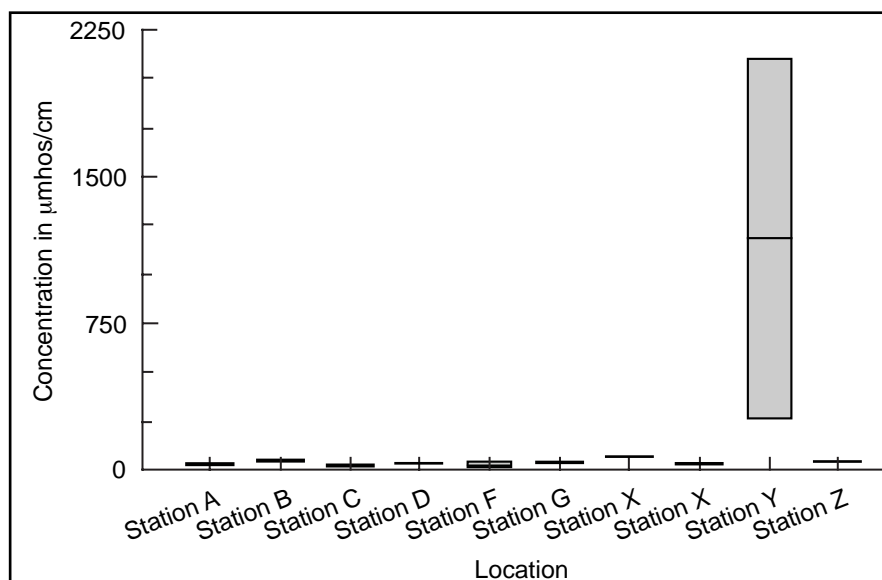


Figure 4-6. Specific conductivity in storm water.

Environmental Monitoring Program

Concentrations detected at Station Y are higher than those detected in 1997. On site concentrations are similar to those detected in 1997.

- Zinc — Zinc concentrations ranged from 0.04 to 0.46 mg/L. The concentrations detected are within the range of those seen in 1997 and previous years when certain metals were analyzed for baseline information.
- Magnesium – Magnesium concentrations ranged from 0.6 to 95 mg/L. The sample with the highest concentration was collected at location Y, which represents stormwater as it flows on site. The highest concentration from a sampling location in the site is 40 mg/L. There is no historical concentration value for comparison.
- Selenium – Selenium concentrations were all below the detection limit of 0.07 mg/L. There is no historical concentration value for comparison.
- Ammonia-N – Ammonia-N concentrations ranged from 0.02 to 0.41 mg/L. There is no historical concentration value for comparison.
- Chemical Oxygen Demand (COD) – COD concentrations ranged from below the detection limit of 7 mg/L to 59 mg/L. The sample with the highest concentration was collected at location Y, which represents storm water as it flows on site. The highest concentration from a sampling location in site is 46 mg/L. There is no historical concentration value for comparison.
- Cyanide – Cyanide concentrations were all below the detection limit of 0.01 mg/L. There is no historical concentration value for comparison.

Environmental Surveillance Results

External Radiation

One of the exposure pathways for population groups living near DOE facilities is external radiation. The only source of external radiation at the SNL/California site is large isotopic radiation sources used for industrial radiography.

Description

Thermoluminescent dosimeters are used to measure the dose rates near SNL/California. Dosimeters are placed at the site perimeter and at more distant locations near the Livermore site. If site operations were contributing significantly to the external radiation dose, the dosimeters at the site perimeter would show a higher dose than those at more distant locations.

Locations

Figure 4-7 shows the locations of the dosimeters at the SNL/California site (near-field). Figure 4-8 shows off-site dosimeter locations (distant).

Methods

LLNL's Environmental Monitoring Group collects the site perimeter and off-site dosimeters quarterly. LLNL's Hazards Control Department processes them. The dosimeters are contained in mylar bags while in the field.

The sampling locations have been chosen (per U.S. Nuclear Regulatory Commission guidance)⁷ to avoid interference from large objects in the vicinity. LLNL uses Panasonic UD814 dosimeters. Each one contains three elements of thallium-activated calcium sulfate and one element of lithium borate. SNL/California uses Bicron/NE model 8807 dosimeters. Each dosimeter contains two lithium fluoride elements. SNL/California Environmental Operations Department personnel collect the four on-site

Environmental Monitoring Program

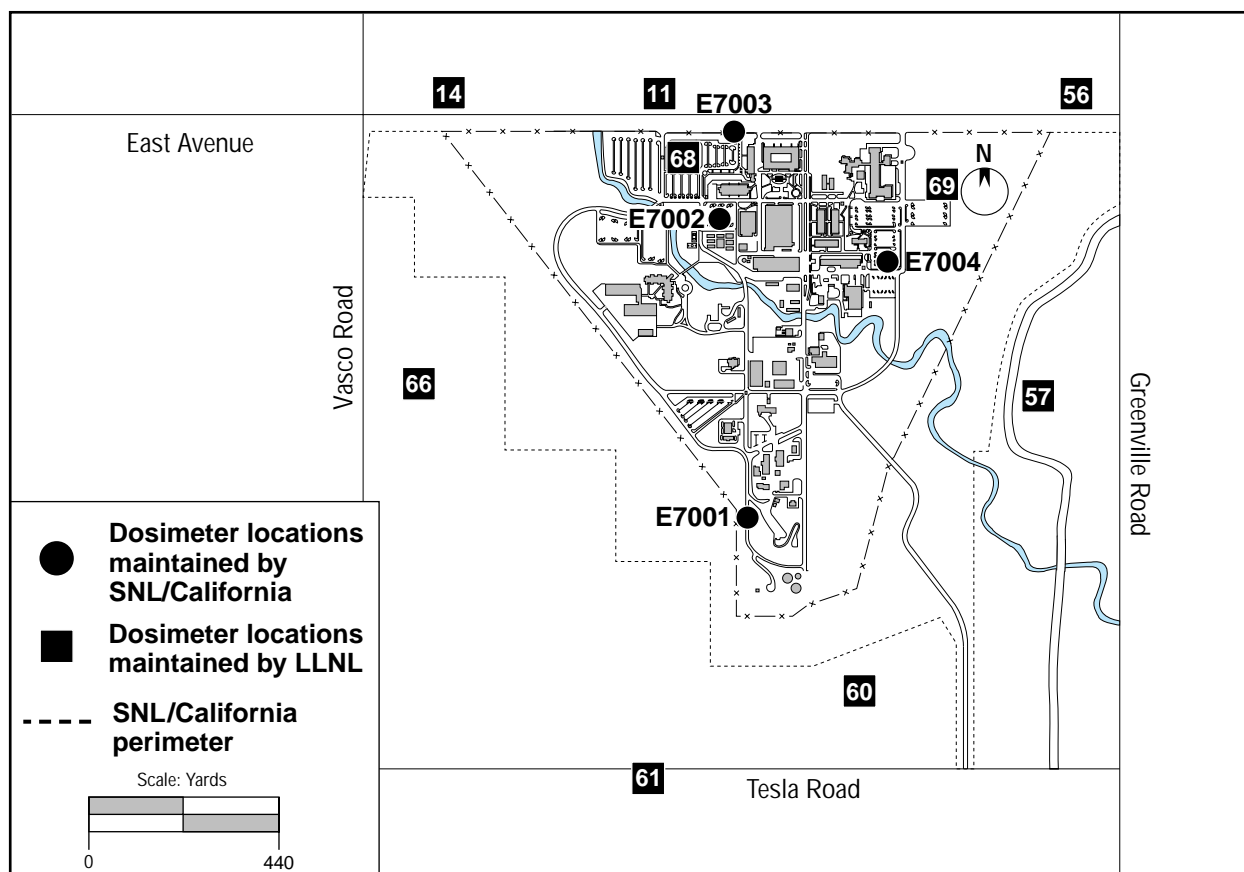


Figure 4-7. Dosimeter locations on the SNL/California site and around the site perimeter.

dosimeters and send them to SNL/New Mexico for analysis.

Quality Assurance

To be acceptable for placement in the field, all phosphors of the dosimeters must be accurate to $\pm 5\%$ upon calibration. Dosimeters with a known exposure are introduced as blind samples in the processing of the field dosimeters. These are equivalent to spiked pseudo samples for the purposes of establishing the accuracy of the system. Duplicate dosimeter packets are placed at random locations and analyzed along with the routine dosimeters. The dosimeters are calibrated by using a source that is traceable to the National Institute of Standards and Technology. The California Department of Health Services also collocates dosimeters at some of the monitoring stations to

serve as an independent cross check. Exposures to the dosimeters during collection and transit are determined by the use of unexposed dosimeters (referred to as "transit controls"). These are taken on the collection route, carried with field dosimeters during transit to the laboratory, and then read for accumulated dose.

Results

The annual average external dose at the SNL/California perimeter was 60.3 mrem (0.63 mSv). The annual average external dose measured for the Livermore Valley locations was 62.4 mrem (0.624 mSv). If operations at SNL/California were producing excess external radiation, the perimeter (near-field) monitoring would show a higher dose than the more distant Livermore Valley monitoring. A Student's t-test comparing the dose at the

Environmental Monitoring Program

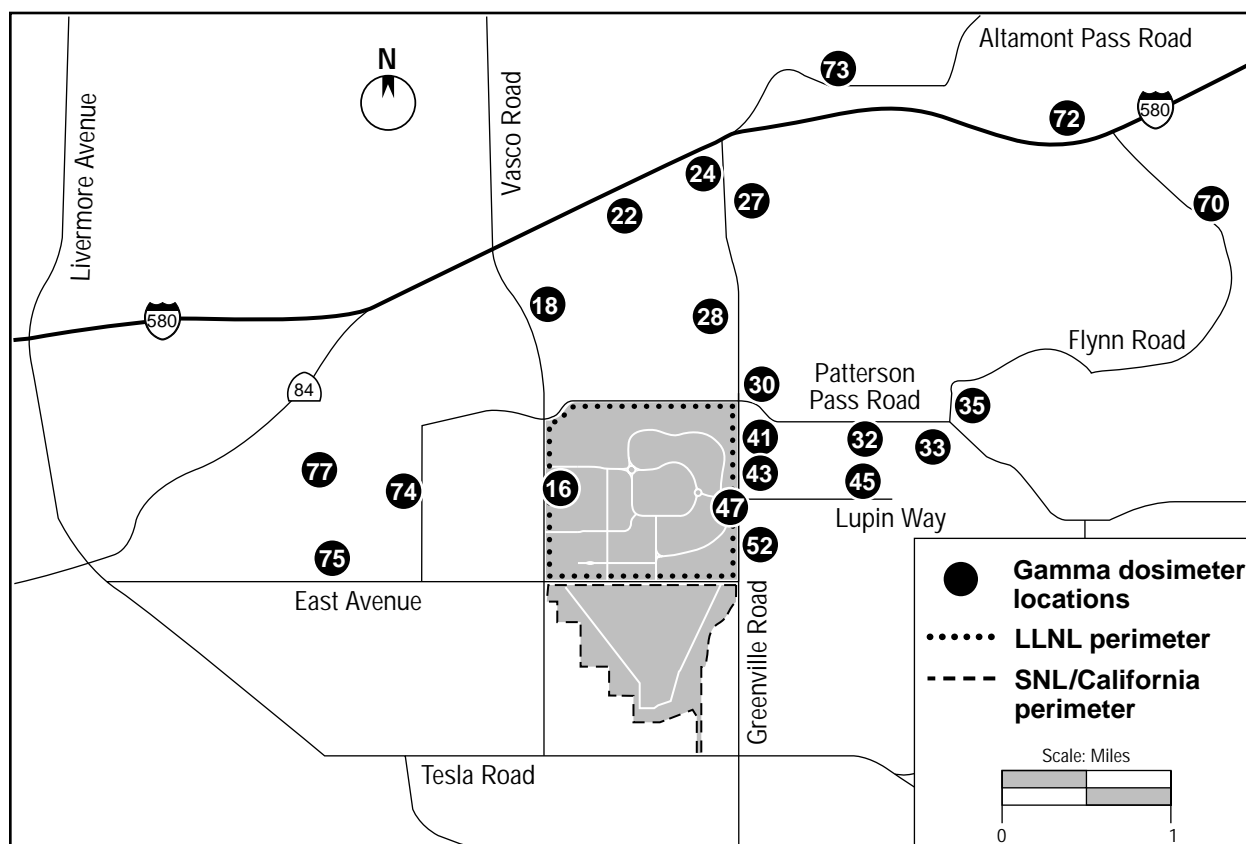


Figure 4-8. Dosimeter locations in the Livermore Valley.

SNL/California site perimeter and the Livermore Valley showed no significant difference.

SNL/California performed a Mann-Kendall trend test on annual average perimeter doses and valley doses for the years 1989 through 1998. The test showed no significant trends at the 95% confidence level for the perimeter and valley samples.

Environmental Impacts

All the significant exposure pathways are sampled as a part of SNL/California's Environmental Monitoring Program. However, most of the pollutants released are at very low concentrations once dispersed in the environment. As a result, levels often are too low to determine

exposure to humans directly from environmental measurements.

References

1. U.S. DOE, Order 5400.5, *Radiation Protection of the Public and the Environment* (March 1988).
2. U.S. EPA, Title 40 CFR, Part 403, *Federal Wastewater Pretreatment Standards* (July 1983).
3. U.S. EPA, Title 40 CFR, Part 433, *Metal Finishing Point Source Category* (July 1994).
4. U.S. DOE, Sandia National Laboratories/California, *Categorical Process Report* (January 1995).

Environmental Monitoring Program

5. U.S. DOE, Sandia National Laboratories/California, *Wastewater Discharge Compliance Report* (monthly).
6. U.S. EPA, Title 40 CFR, Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants* (1992, latest revision).
7. U.S. Nuclear Regulatory Commission, Regulatory Guide 4.13, *Performance Testing and Process Specifications for Thermoluminescent Dosimetry*, Environmental Applications, Revision 1 (July 1977).

Environmental Monitoring Program

Table 4-1. Environmental Sampling Program Overview.

Medium	No. of Locations	Parameters	Frequency	Requiring Authority	Authority Reported to
Groundwater	29	volatile and semivolatile organics, metals, general minerals, diesel, tritium, radium, and uranium. One well monitored for water level only.	quarterly	RWQCB ^a DOE Order 5400.1	RWQCB, DOE
Sewer outfall	1	metals, cyanide, BOD, COD, oil and grease, TDS, TSS, pH, tritium, conductivity, pesticides ^b , volatile and semi-volatile organics ^c	sampled continuously or grab; analyzed weekly or monthly	City of Livermore, Municipal Code Ch. 13.32, DOE Order 5400.1	City of Livermore, DOE
Storm water	11	conductivity, pH, TSS, oil and grease, metals, pesticides, volatile and semivolatile organics, tritium, cyanide ammonia COD	two storms per sampling location	City of Livermore Municipal Code Ch. 13.45, DOE Order 5400.1	SWRCB ^d RWQCB, County of Alameda, City of Livermore, DOE
External radiation	33	radiation dose	quarterly	DOE Orders 5400.5, 5400.1	DOE

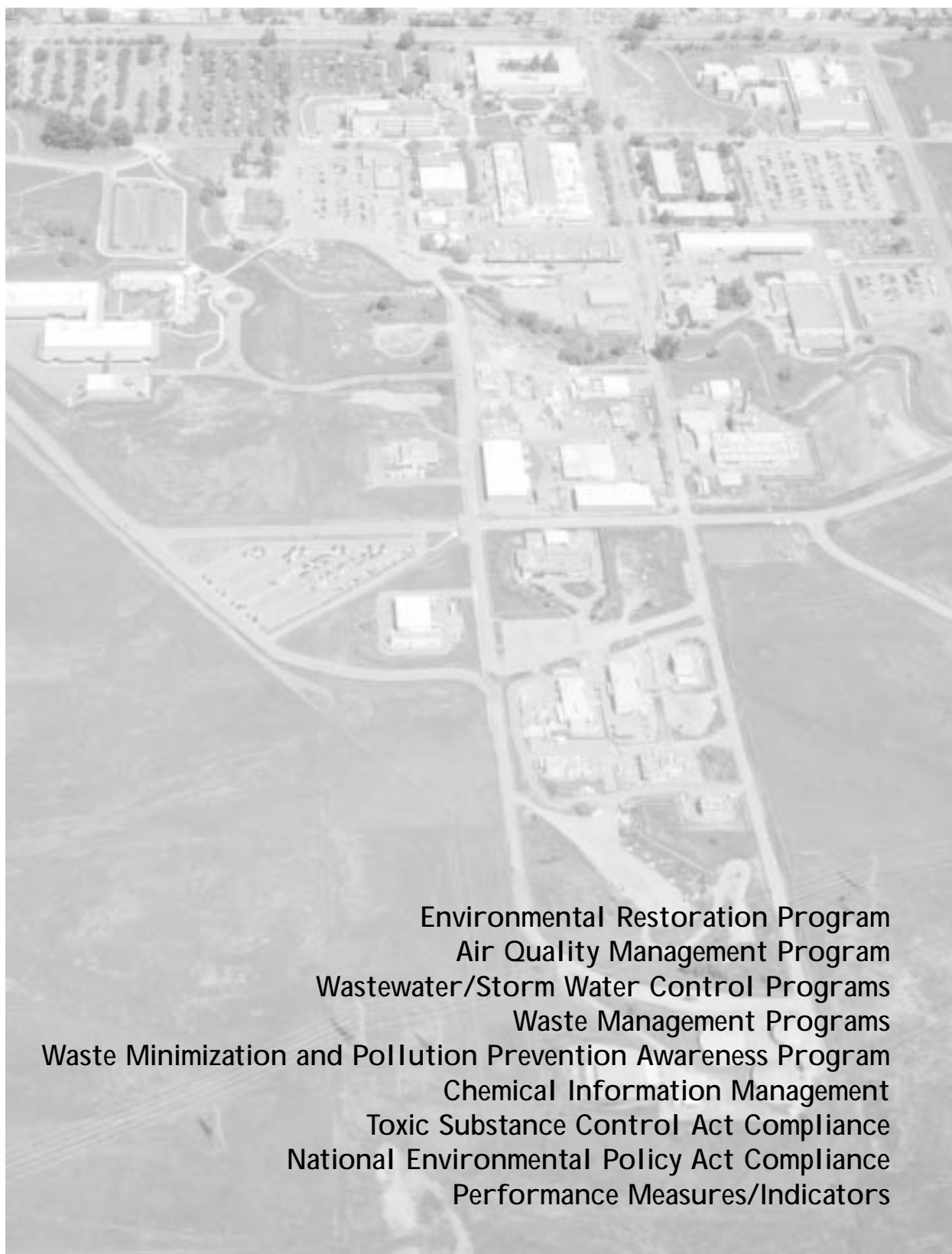
^aRegional Water Quality Control Board.

^bSNL/California Wastewater Discharge permit was modified by City of Livermore to remove pesticides from the required sampling parameters. This modification became effective May 1998.

^cBOD = biological oxygen demand, COD = chemical oxygen demand, TDS = total dissolved solids, TSS = total suspended solids.

^dState Water Resources Control Board.

5 – Environmental Program Information



Environmental Restoration Program
Air Quality Management Program
Wastewater/Storm Water Control Programs
Waste Management Programs
Waste Minimization and Pollution Prevention Awareness Program
Chemical Information Management
Toxic Substance Control Act Compliance
National Environmental Policy Act Compliance
Performance Measures/Indicators

Environmental Program Information

Environmental Restoration Program

CERCLA and SARA mandate cleanup of toxic and hazardous contaminants at closed or inactive waste sites.

SNL/California activities related to these laws are being addressed under the DOE Environmental Restoration Program and are directed by the San Francisco Regional Water Quality Control Board.

During 1998, SNL/California was involved in remediating two sites (Fig. 5-

1): the Fuel Oil Spill and the Navy Landfill. A third previously listed site, the Trudell Auto Repair Shop, was cleaned up and officially closed in 1990. In addition, investigations were completed in 1993 at five sites with suspected contamination (Miscellaneous Sites). The Regional Water Quality Control Board closed these sites, with no further action required, in 1994. The Regional Water Quality Control Board Site Cleanup Order 88-142,¹ issued in September 1988, directs cleanup activities at SNL/California. This Order was

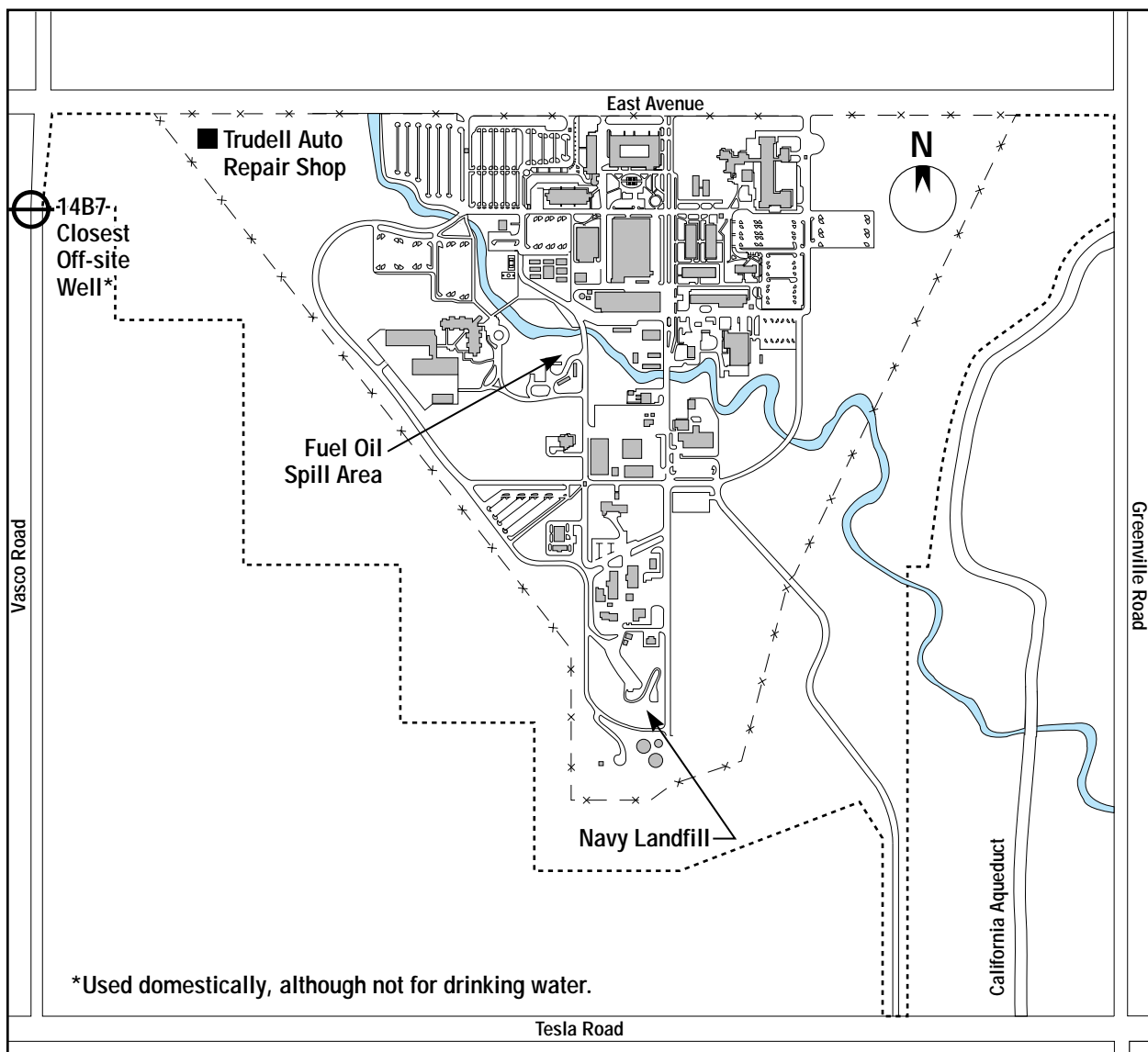


Figure 5-1. SNL/California remediation sites.

Environmental Program Information

modified in 1989 for the Fuel Oil Spill (Order 89-184).² The Engineering for Information Systems Department is conducting these restoration activities, as described below.

Fuel Oil Spill

In 1975, as the result of an accidental puncture of an underground transfer line, 59,500 gallons of #2 diesel fuel spilled into the vadose zone from an above-ground reserve fuel tank. SNL/California has monitored the groundwater in this area since 1985. It shows occasional low-level contamination with fuel oil components. Neighboring farmers sometimes use this aquifer as a source of drinking or agricultural water.

SNL/California completed a remedial investigation of the spill site in November 1988. In 1990, SNL/California, Argonne National Laboratory, and the University of Notre Dame performed several bench-scale tests to determine the most effective means of cleanup. The resulting treatability report indicated that bioremediation would be the most effective of the technologies tested in reducing fuel oil contamination. In 1991, *in situ* bioremediation tests were done. Bioremediation was proven effective, but in the field it proceeds at a slower rate than laboratory tests done in slurry reactors.

In December 1990, Argonne began groundwater flow and contaminant transport modeling to support the pilot bioremediation system design. Using a computer code developed at Los Alamos National Laboratory and monitoring well data, experts at Los Alamos prepared a three-dimensional model characterizing the spill area. Argonne conducted additional bench-scale studies at Notre Dame to establish required nutrient and oxygen levels and to identify degradation products. SNL/California completed three groundwater wells downgradient of the

spill site to control and monitor the spread of the contaminated groundwater.

After heavy rainfall in the spring of 1993, the groundwater at the Fuel Oil Spill site rose about 3.6 m (12 ft). Diesel and BTEX contamination were noted during the second-quarter groundwater sampling. As a result, the Regional Water Quality Control Board directed SNL/California to implement an Interim Remedial Measure, a groundwater treatment system. Because SNL/California planned to move the system to a permanent location (to serve as the water treatment system for the Fuel Oil Spill pilot study nutrient injection and withdrawal systems), it was termed the "Temporary Interim Remedial Measure."

In the fall of 1993, the Regional Water Quality Control Board approved SNL/California's work plans for the Fuel Oil Spill pilot study and the Temporary Interim Remedial Measure. SNL/California completed the Fuel Oil Spill site plan in October 1993 and the Temporary Interim Remedial Measure work plan and system design in December 1993.

SNL/California completed site preparation—including fencing, gates, site grading, gravel, and paving—in December 1993. Using the conceptual design from Argonne National Laboratory, SNL/California installed a free product separator and carbon filtration beds in January 1994. The Temporary Interim Remedial Measure went on line in early February 1994.

In March and April 1994, SNL/California drilled ten monitoring boreholes and installed downhole instrumentation, five injection/withdrawal wells, four Zone 1 withdrawal wells, and five geophysical logging boreholes. SNL/California set up a small land farm (ex situ bioremediation) to treat the drill cuttings from the wells and boreholes. The land farm reduced the contamination in the withdrawn soil to less than 50 ppm, and in 1995, it was closed.

Environmental Program Information

During the summer of 1994, utility hookups were completed, and the data acquisition software was finished and installed. Following these activities, SNL/California installed a subsurface infiltration gallery, seven tensiometers, and a remote barometer at the pilot study site. Multiplexers and data loggers were installed and connected to the computers. The data collection computer system began baseline monitoring for temperature, pressure, and soil moisture. This system comprised 158 information channels collecting data once every minute, 24 hours per day.

In late November 1994, SNL/California completed the construction of the pilot study system. The components of the Temporary Interim Remedial Measure were moved into the pilot study system and were tested. The Final Interim Remedial Measure now is continuously operating.

SNL/California conducted a small-scale, flow-through test in April 1995. The bioremediation pilot study began in June 1995, with the first phase of the process: injection of water into the ground. The water contained the necessary nutrients for in situ bacterial growth: nitrogen and phosphorus, with calcium and magnesium salts added to modify the soil properties. Using low to moderate flow rates of 1.5 to 6.0 gallons per minute, SNL/California technicians injected nearly 2,000,000 gallons of water into the contaminated soil.

In October 1995, the injection system was shut down, and the second, withdrawal phase began. About 60,000 gallons of water were removed and treated; the rest remains in the pores of the soil to facilitate the bioremediation.

In November 1995, the third phase—aeration—began. Air was forced into the soil and then pulled from the soil at a low rate (about 5 ft³ per minute). This phase continued through the end of 1995.

In 1996, the cycles (nutrient injection, withdrawal, and aeration) continued. The year ended with the third injection phase

which began on September 24. The nutrient mix for the third injection phased consisted of 25 mg/L of ammonium nitrate and 1 mg/L of phosphoric acid. Nutrients were injected through all eight pilot study injection points along with the infiltration gallery at a flow rate of 1.5 gallons/minute at each location. The third-cycle, nutrient injection was completed on December 12. Approximately 842,000 gallons of water and nutrient were injected through the injection wells and 199,000 gallons through the infiltration gallery.

During the second half of the 1996, SNL/California began performing carbon dioxide (CO₂) measurements in the monitoring wells within the pilot study area. The CO₂ concentrations have been extremely high, which indicate that significant biodegradation is occurring. Later, monitoring wells outside of the pilot study area were sampled, and significant CO₂ levels were found in the wells where contamination is located. This suggests that the pilot study injections are affecting an area substantially larger than the pilot study area. Work is continuing with the CO₂ measurements to determine the level of biological activity and the area being impacted by the pilot study bioremediation.

In 1997, the injection, withdrawal, and aeration phases continued as scheduled. In April, near the end of the fourth cycle injection phase, five boreholes (three were completed as wells) were drilled in order to perform soil sampling in locations adjacent to the pilot study area. The goals of the soil sampling was to better determine the horizontal extent of the pilot study bioremediation and to more accurately determine the levels of diesel cleanup. It was determined from the boreholes that the area being remediated is significantly larger than the pilot study area especially at the 50-100 foot depths. Cleanup levels were found to vary from location to location with the greatest levels of cleanup at the deeper depths.

Environmental Program Information

The CO₂ levels, TPH sampling, lysimeter sampling, and the soil sampling data all compare favorably.

The fifth cycle withdrawal phase began and ended in May. This was followed by the aeration phase, which ended in the middle of September. The fifth cycle nutrient injection phase began September 15 and ended October 31. All injection cycles, since cycle two, have been completed by injecting approximately 1 million gallons of water and nutrient. The fifth cycle withdrawal phase began on November 3 and ended on November 23. The aeration phase began on November 24 and continued through the end of the year.

The sixth cycle injection phase began in March 1998 and ended in April. Approximately 1 million gallons of water and nutrient were injected during this time. The injection cycle was followed by the withdrawal cycle which lasted approximately one month. This was followed by the sixth aeration cycle. The aeration cycle continued through the end of the year.

During a site visit with the Regional Water Quality Control Board, it was decided that because of the new information concerning diesel spills (Leaking Underground Fuel Tank study etc.) that full scale bioremediation might not be necessary for the Fuel Oil Spill site. Since the contamination has been present without much movement since the mid 70s it was decided that SNL/California would perform a risk assessment (using the ASTM standard for diesel spills) and seek a risk-based closure of the Fuel Oil Spill site. In 1998, a risk assessment and closure request were submitted to the Regional Water Quality Control Board. The risk assessment was performed using the ASTM standard for diesel spills. The RWQCB accepted the risk assessment but has asked for additional information to determine plume stability before making a closure decision. SNL/California provided this additional data package in January 1999. When closure of the Fuel

Oil Spill site is approved, SNL/California will have no further ongoing remediation activities other than limited groundwater monitoring.

Navy Landfill

An inactive landfill is located at the southern end of the SNL/California site. It was used by the Navy during and shortly after World War II, and again by LLNL in the 1950s and early 1960s. A survey of historical records and landfill contents indicated that only general construction debris and machine turnings were disposed of at the site. There is no indication of any hazardous materials being buried at this landfill. The landfill measures approximately 11,300 m² in area and 68,800 m³ in volume.

The landfill appeared on the State of California's Solid Waste Water Quality Assessment Test Program list in December 1987. Consequently, the State required a wastewater quality assessment test proposal (equivalent to a remedial investigation plan). SNL/California submitted the proposal in March 1993 and a report in 1994.^{3,4}

To characterize the site, SNL/California installed an upgradient well, three downgradient wells, a piezometer, and two lysimeters. Two additional wells were installed in 1993, under the direction of the Regional Water Quality Control Board, to provide additional information about the groundwater at the site.

In November 1994, SNL/California received a recommendation for closure of the landfill from the SWRCB.

After further review of the site data in early 1996, SNL/California and DOE suggested that an enlarged cover over the Navy Landfill may not be necessary to protect human health and the environment.

In August 1996, the DOE submitted to the Regional Board a request for Inert Classification. The DOE and SNL/California requested that the Navy

Environmental Program Information

Landfill be categorized as containing only inert waste and, therefore, not subject to the closure requirements in CCR Title 23, Chapter 15, Article 8. The data presented in the request support the conclusions that 1) the Navy Landfill contains only inert waste, 2) the Navy Landfill waste is not degrading the quality of groundwater, and 3) the Navy Landfill in its current state does not pose a threat to the public health or environment.

During a site visit in March of 1997 to discuss our request for Inert Classification, the RWQCB stated that Inert Classification would be extremely difficult to obtain. The RWQCB suggested that we perform a risk assessment of the Navy Landfill and seek a risk-based closure of the site. In October of 1997, a risk assessment and closure plan were submitted to the RWQCB. The closure request was approved in March 1998. Closure of the NLF was approved if the following conditions were satisfied:

1. Groundwater monitoring is continued on a quarterly basis at monitoring well NLF-6, where carbon tetrachloride is intermittently detected.
2. An adequate vegetative cover is applied to the landfill, such that there are no exposed areas.
3. Erosion control measures are followed in accordance with the submitted erosion control plan.

Erosion control measures were implemented at the NLF site beginning April 1, 1998. The use of herbicides for weed control and fire protection has ceased, which will significantly alleviate the potential for erosion. We will continue to follow all of the erosion control measures outlined in our erosion control plan.

Because of the late, spring rains, the cleanup of the NLF site did not begin until June 22, 1998. The objective was to remove all debris (concrete, re-bar, etc.) not integral to the composition of the hillside. During the thirteen-day duration of the project, a total of 31.6 tons of concrete rubble, monoliths and debris was

removed and disposed of at an offsite landfill. All areas were inspected to ensure that loose debris was removed and that all exposed re-bar was cut at or below ground level. Two areas that had shown signs of eroding were repaired. All exposed areas resulting from removal activities were backfilled with clean, imported materials and hydroseeded for erosion control. Additionally, all eight of the explosive magazines that are located just outside the NLF boundary were covered with erosion control mats to prevent further wind and rain erosion.

Five monitoring wells and two lysimeter wells were pressure routed by a California licensed driller and the well heads were removed and destroyed per the requirements of the Zone 7 Well Destruction Permit. The destroyed wells were filled and finished to match the surrounding areas. All NLF site closure activities were completed on July 9, 1998.

SNL/CA and DOE now consider the Navy Landfill a closed site. All of the RWQCB closure conditions have been satisfied. We will continue to monitor NLF-6 and to follow our erosion control plan. At the end of two years we will evaluate the sampling results from NLF-6 and the stormwater sampling results to determine if continued sampling is warranted.

Underground Storage Tank Management

SNL/California complies with Federal and State requirements for underground storage tanks.⁵ SNL/California has two regulated underground storage tanks.

One 500-gallon tank was installed in a vault behind Bldg. 964 in 1986 to store diesel fuel for emergency power generators. It is constructed of double-walled fiberglass and is equipped with a Leak Alert™ system (Universal Sensors & Devices), which meets all tank monitoring requirements.⁵ The Leak Alert™ system has two sensors—metal-oxide semiconductors—which detect organic vapors. These sensors are connected to a

Environmental Program Information

signal panel, which emits both audio and visual alarms.

The second underground storage tank is a 950-gallon steel tank in a containment vault located below grade, north of the former Tritium Research Laboratory. This tank stores diesel fuel for the building's emergency generator.

Both tanks have some minor deficiencies which preclude them from being compliant with the new 1998 UST regulations. On December 21, 1998, both underground storage tanks were disconnected and drained with regulatory approval. In early 1999, SNL/California will conduct an assessment to determine whether it is better to upgrade one or both tanks to meet the new regulatory requirements or to remove the tanks permanently.

Spill Prevention Control and Countermeasure Plan

The *Spill Prevention Control and Countermeasure Plan* establishes procedures for controlling, and if necessary, remediating oil spills at SNL/California.⁶ The plan was prepared in accordance with Title 40 CFR, Part 112.⁷ It was approved in June 1997. Site personnel have been trained in spill response procedures.

Air Quality Management Program

Operations at SNL/California are subject to the rules and regulations of the Bay Area Air Quality Management District (BAAQMD), the State Air Resources Board, and the EPA, which have jurisdiction over facilities that emit air contaminants. In 1998, SNL/California continued activities to assure site-wide compliance with air quality regulations. These activities are directed toward ensuring adequate evaluation of air permit requirements and other applicable regulations.

SNL/California's Air Quality Management Program identifies and evaluates potential sources of air pollu-

tants, and documents compliance requirements. The Environmental Operations Department's Air Quality Program maintains the site-wide air emissions source inventory, which provides data on materials, equipment, and operations that are subject to air quality regulations. The Air Quality Group also prepares applications for air permits or exemption requests as needed in conjunction with this inventory.

In 1998, SNL/California operated 24 permitted sources and 30 exempt sources (see Chapter 3, "Compliance Summary"). SNL/California reports air emissions from these sources to the BAAQMD as part of the annual permit renewal.

Wastewater/Storm Water Control Programs

Wastewater Management Program

The primary goal of the Federal Clean Water Act is to protect and restore the integrity of the nation's waterways. The Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES), which requires permitting of all point-source liquid effluent discharges. These permits contain specific criteria for discharging liquids to waterways. The State of California has authority to enforce the requirements of the Clean Water Act. The Livermore Water Reclamation Plant is responsible for issuing and enforcing SNL/California's wastewater permit. The permit contains specific pollutant limitations and monitoring requirements for discharging wastewater to the municipal sewer system.

During the last few years, the government has implemented more stringent regulations governing industrial wastewater discharges to public sewer systems. SNL/California always has maintained a program to control liquid effluents. This program incorporates administrative and engineering controls to prevent

Environmental Program Information

contaminated wastewater from being discharged to the municipal sewer system.

SNL/California has developed a Wastewater Minimization Program to reduce pollutants in wastewater discharge, protect the environment, and ensure compliance with Federal, State, and local regulations. SNL/California has also developed a web page for SNL/California's internal web. The web page provides general guidelines to SNL/California personnel about what can and cannot be discharged into the sanitary sewer system. Twice a year a notice is placed in the daily bulletin (TNT) to remind the SNL/California personnel that they must comply with these guidelines.

Liquid Effluent Control Systems

The Liquid Effluent Control Systems (LECS) are key elements of SNL/California's wastewater management. The LECS comprise large, monitored, holding tanks, which collect and retain wastewater generated at key facilities. These systems allow SNL/California to analyze the wastewater and verify that its constituents are within acceptable limits before discharging it to the sanitary sewer system. SNL/California has six LECS in operation, at the following locations (see Fig. 4-1 in Chapter 4): Bldg. 913 (miscellaneous laboratories), Bldg. 910 (Printed Wiring Laboratory), Bldg. 961 (Hazardous Waste Facility), Bldg. 968 (the Chemical and Radiation Detection Laboratory), Bldg. 906 (Combustion Research Facility), and Bldg. 941 (Integrated Manufacturing Technologies Laboratory).

Sewer Diversion Facility at LLNL

The combined SNL/California and LLNL sewer effluent is discharged to the City of Livermore municipal sewer system at the

northwest corner of the LLNL site. To better control effluents and increase protection of the Livermore Water Reclamation Plant, LLNL and SNL/California constructed a sewer diversion facility at LLNL. This system can retain approximately 200,000 gallons of contaminated sewage on site, if necessary, for further evaluation.

Storm Water Management Program

Amendments to the Clean Water Act in 1987 require permits for storm water discharges from municipal storm drain systems and storm water discharges associated with industrial activities.

In 1990, the U.S. EPA published specific permit requirements. With permitting authority, California's State Water Resources Control Board adopted the Industrial Activities NPDES Storm Water General Permit in 1991, which was reissued in April 1997. It allows industrial facilities in California* to be in compliance with the Federal storm water permitting requirements by filing a Notice of Intent with the Board. SNL/California has filed a Notice of Intent and must comply with the requirements of the permit.

Although the State Water Resources Control Board (SWRCB) administers the storm water permit, SNL/California is regulated by the San Francisco Bay Regional Water Quality Control Board (Regional Board).⁸

In response to the permitting requirement of the Federal Clean Water Act for municipal storm water discharges, the City of Livermore and Alameda County Flood Control & Water Conservation District adopted ordinances that also require SNL/California to manage storm water discharges to the municipal storm drainage system. However, under a memorandum of understanding with the Regional Board, the Regional Board is the lead regulatory agency for federal facilities such as SNL/California.

SNL/California complies with Federal, State, and local storm water requirements through a comprehensive

* The California General Industrial Activities NPDES Storm Water Permit applies to regulated facilities throughout California, except facilities located in Santa Clara County. The San Francisco Bay Regional Water Quality Control Board has adopted a separate NPDES permit for facilities in Santa Clara County.

Environmental Program Information

Storm Water Management Program. This program includes the Storm Water Pollution Prevention Plan and the Storm Water Monitoring Program.

Storm Water Pollution Prevention Plan

The *Storm Water Pollution Prevention Plan* identifies activities that result in non-storm water discharges to the storm drain system and describes how these discharges are eliminated.⁹ It identifies sources and activities that could allow pollutants to be deposited on impervious surfaces and picked up by storm water runoff. It also describes how SNL/California minimizes these pollutant sources discharged with storm water runoff by implementing best management practices.

Because the SNL/California site continually changes, the *Storm Water Pollution Prevention Plan* is a living document. It is updated regularly to reflect these changes.

Storm Water Monitoring Program

The purpose of the Storm Water Monitoring Program is to optimize SNL/California storm water pollution prevention activities. It consists of extensive visual inspection and sampling activities, which include:

- *Quarterly Visual Inspection for Non-stormwater Discharges*—Under the general permit, certain non-stormwater discharges without pollutants are authorized to discharge to the storm drains. Quarterly visual inspections are performed for non-stormwater discharges. Inspectors look for unauthorized non-stormwater discharges from the site and visually observe authorized non-stormwater discharges and their sources to ensure there are no pollutants.
- *Wet Weather Visual Inspection*—SNL/California also inspects all storm drain outfalls discharging into the site's two main storm water conveyances during storms to see if

storm water runoff picked up visible pollutants from the site. These inspections are conducted once per month from October through April, during storms that produce runoff.

- *Storm Water Sampling*—When there was enough to produce runoff, SNL/California collects storm water samples from up to ten sampling locations, during at least two separate storms. The exception is location N which was added beginning with the 1997/98 wet season. Chapter 4 describes each sampling location and the results of SNL/California's storm water sampling activities in 1998.
- *Annual Site Inspection*—The annual site inspection ensured that best management practices were effectively implemented. Findings from the site inspection were used to evaluate and update the Storm Water Pollution Prevention Plan.

Storm water monitoring information is used to identify potential sources of pollutants and non-storm water discharges.

In 1998, SNL/California completed all wet weather visual inspections, the annual site inspections, and the quarterly visual inspections for non-stormwater for July through September. Two storm water samples were collected from all storm water sampling locations except for locations N and Y, and locations N and Y did not have sufficient flow to collect samples during the first storm event of the 1998/1999 wet season.

Waste Management Programs

The Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984, requires a comprehensive program for managing hazardous wastes from generation to ultimate disposal. The primary goals of RCRA are to reduce the volume and toxicity of wastes and to minimize the amount of waste requiring

Environmental Program Information

land disposal. The California Hazardous Waste Control Law is similar to, but more restrictive than, RCRA. The EPA authorized the State to assume RCRA authority in August 1992. This authority is enforced by the Cal/EPA's Department of Toxic Substances Control.

Hazardous waste activities at SNL/California include collection, on-site transportation, consolidation, treatment, and storage of energetic, radioactive, mixed, and nonradioactive hazardous wastes. SNL/California has not and does not plan to dispose of hazardous wastes at the site. SNL/California was granted a RCRA Part B Permit for the storage of hazardous waste in January 1993. The permit is effective until January 2003.

Hazardous Waste Program

Hazardous waste is defined as a material with no further end use, which is not radioactive, but contains constituents that may be harmful to human health or the environment. RCRA wastes are regulated by the U.S. EPA and the Cal/EPA. Non-RCRA wastes are regulated by the Cal/EPA.

SNL/California sends all nonradioactive wastes generated on site to permitted commercial facilities for treatment or disposal. SNL/California shipped an average of approximately 5288 kg/month chemical waste off site for disposal in 1998.

Low-Level Radioactive Waste Program

The low-level radioactive waste management activities at SNL/California include handling, packaging, and storing of radioactive waste. Most of the program work completed this year was shipment to Nevada Test Site. SNL/California shipped approximately 3975 kg of low-level radioactive waste to the Nevada Test Site in 1998. Less than 10 m³ of waste from other research and development activities are in the storage facility, packaged in DOT-specification containers. No transuranic or high level radioactive

waste are generated at the SNL/California site.

Mixed Waste Program

Mixed waste is a hazardous waste that also contains radionuclides regulated by the Atomic Energy Act. SNL/California's Mixed Waste Program has taken major steps to meet compliance objectives of the Federal Facilities Compliance Act. SNL (both the California and the New Mexico sites) has consolidated all cost and compliance liability associated with the storage, treatment, and disposal of mixed waste. As of March 30, 1995, SNL/California met all compliance requirements for the Federal Facilities Compliance Act. Mixed waste generated at SNL/California (which averages less than 0.4 m³ per year) has been shipped from point-of-generation to SNL/New Mexico or to other permitted treatment facilities for management. In 1998, 1.0 m³ of mixed waste was transferred to SNL/NM for treatment and final disposal.

Waste Minimization and Pollution Prevention Awareness Program

SNL/California has supported various waste minimization activities since 1985. These efforts have evolved into the Waste Minimization and Pollution Prevention Awareness Program. The program's principal objective is to maximize all opportunities for eliminating or minimizing waste through source reduction, reuse, and recycling. Waste that cannot be reduced, reused, or recycled is treated through available treatment technology or sent out for disposal. The program reflects ongoing efforts to integrate pollution prevention and waste minimization into the site's operating philosophy. The increases in waste management costs and the public's interest in environmental issues provide added incentives for an effective program.

SNL/California has implemented a variety of waste minimization techniques.

Environmental Program Information

These are supported by employee training programs aimed at reducing waste while meeting the company's requirements for quality, productivity, safety, and environmental compliance.

A key element of the Waste Minimization and Pollution Prevention Awareness Program is the development of baseline information on waste generation. Sandia has established a corporate Pollution Prevention Team to assist in the ongoing evaluation and evolution of the waste minimization program. Its primary functions are to make all SNL/California employees aware of the program, identify tasks to implement the program, and provide a mechanism for communicating waste minimization issues within the SNL/California community and to the public. The Pollution Prevention Team is responsible for developing, designing, creating, and overseeing implementation of waste minimization projects. Waste generators are responsible for implementing the program.

SNL/California's waste minimization and pollution prevention efforts demonstrate both the commitment and involvement of SNL/California's management and staff. These efforts include the following:

- Waste Minimization and Pollution Prevention awareness has been incorporated into several required ES&H training courses and is provided at monthly new-hire orientations.
- SNL/California annually holds an employee awareness program on environmental issues. In 1998, during the annual Pollution Prevention Week, SNL/California emphasized the use of environmentally friendly methods to control pests in the garden.
- The corporate Solvent Substitution Technical Advisory Committee and Chlorofluorocarbon Elimination Working Groups help users find less hazardous or nonhazardous solvents and cleaning agents.

- SNL/California employees substitute safe alternatives for hazardous chemicals whenever possible.
- SNL/California's trip reduction program continues to reduce air pollution by reducing vehicle trips to the site.
- Green waste is collected and disked into the fields. Branches and shrub cuttings are processed through a shipper/shredder and used in weed control and ground covering.
- SNL/California recycled 1277 toner cartridges in 1998, which saved more than 500 ft³ of landfill space.
- SNL/California's metal recycling program recycled 91.82 metric tons of mixed metals in 1998.
- The Property Reapplication and Reclamation Department reassigns excess equipment to other SNL organizations or to organizations outside of Sandia. In 1998, Sandia/California donated more than 478 computers and related equipment, valued at \$112,764, to local schools.
- The SNL/California site recycles paper, cardboard, and aluminum cans. In 1998, more than 23.3 metric tons of paper, 0.26 metric ton of aluminum cans, and more than 14 metric tons of cardboard were collected for recycling.
- More than 0.54 metric tons of tires from Sandia/California's Maintenance Department were recycled in 1998 as a part of LLNL's tire recycling program.
- SNL/California recycles hazardous wastes whenever possible. Some examples are batteries, mercury, fluorescent light tubes, coolants, petroleum oil, empty drums, and lead. The Waste Management Group also recycles nonhazardous laboratory glass.

The Waste Management Department tracks all regulated waste generation information. The Facilities Operations

Environmental Program Information

and Property Management departments track and maintain all nonhazardous waste information. The quantities listed in Table 5-1, except for sanitary waste, are based on the manifested shipment database for calendar years 1997 and 1998, respectively. Table 5-2 shows the results of SNL/California's recycling efforts in 1998.

Chemical Information Management

The Environmental Operations Department implemented a site-wide Chemical Information System/Material Safety Data Sheet management system in 1992. This system is designed to help SNL/California more effectively comply with Federal, State and local regulations and DOE orders, and to improve the operating efficiency in chemical work areas. It is a computer database, which tracks chemical containers in facilities by barcode labels. It has several unique features, including flexible software, which permits SNL/California to customize it for the inventory's special needs. The system provides detailed information on chemical inventory and usage on site, thus supporting numerous ES&H programs and activities. These major programs and activities include:

- Chemical Information Management—Emergency Planning and Community Right-to-Know Act (EPCRA) and the California Hazardous Material Management Plan reporting;
- Industrial Hygiene—Chemical Information for Personnel Hazards Communication Information (Employee Right-to-Know/Material Safety Data Sheets);
- Health Physics—radioactive material tracking;
- Waste Management—waste container tracking and hazardous material and spill information;

- Pollution Prevention—chemical inventory and usage on site;
- Air Quality—chemical inventory and usage on site;
- Storm Water/Wastewater—chemical inventory and usage on site;
- Emergency Preparedness—chemical inventory, hazardous material information, and spills;
- Fire Protection—chemical inventory and hazardous material information;
- Explosives—hazardous material information;
- General resource for ES&H and Laboratory-wide audits, surveys, and information requests.

Toxic Substance Control Act Compliance

The Toxic Substance Control Act (TSCA) establishes regulations to control the use of and exposure to new industrial chemicals. It identifies toxic substances and regulates their manufacture, use, storage, handling, and disposal. TSCA requires premanufacturing notification and evaluation of new chemicals to assess the health and environmental risks. It also regulates the use, inspection, and disposal of polychlorinated biphenyls (PCBs).

The Lead/Asbestos Abatement Program (Dept. 8821) works closely with SNL/California maintenance and facilities personnel in order to identify and properly deal with any asbestos-containing materials encountered during maintenance or construction activities.

National Environmental Policy Act Compliance

During 1998, 136 SNL/California projects were evaluated, and NEPA classifications and/or determinations made. Of the projects evaluated, 114 underwent an SNL/California internal review and were classified as included within the scope of existing documentation. Existing NEPA

Environmental Program Information

documentation at the California site includes the site-wide Environmental Impact Statement and seven umbrella categorical exclusion determinations. The remaining 22 projects were transmitted to the DOE/Kirtland Area Office for a NEPA determination. All 22 projects that required a DOE determination were found to be categorically excluded from the need to prepare an Environmental Assessment or Environmental Impact Statement.

Performance Measures/Indicators

Environment, safety, and health (ES&H) performance has been measured using performance indicators at Sandia for many years. However, the program has had a limited scope. Currently, SNL has a defined hierarchy of performance indicators, with a comprehensive set of lab-wide indicators at the top and more detailed, organization-specific indicators at the bottom.

For reporting to the DOE, the top-level indicators are categorized into four general areas: protection of people, protection of the environment, compliance, and management practices; and two types: outcomes and precursors.

The top-level precursor indicators are derived from lower level indicators, which have been developed and used by organizations to safely manage their workplaces to achieve the desired overall ES&H outcomes. The outcomes indicators measure and trend the overall ES&H performance at SNL, whereas the precursor indicators may show trends in the performance of ES&H processes intended to achieve those outcomes. The correlation of process performance to outcomes performance is used to pinpoint key performance indicators to monitor ES&H.

An ES&H Oversight Pilot team, which consists of both SNL and DOE representatives, is developing an updated set of corporate ES&H performance indicators for SNL to meet the needs of the DOE's current performance-based oversight and assessment objectives. The SNL organization responsible for this effort is the Emergency Management and Operations Evaluation Department. These new performance indicators will be designed to show trends before significant problems occur and will become a key part of the ES&H portion of the annual DOE/SNL laboratory appraisal. The top-level indicators will evolve to include proven key indicators. Each SNL division will be responsible for developing its own set of performance indicators that can be used to measure performance. These also will be evaluated during the annual DOE/SNL laboratory appraisal.

References

1. State of California, San Francisco Bay Regional Water Quality Control Board, Order 88-142 (September 21, 1988).
2. State of California, San Francisco Bay Regional Water Quality Control Board, Order 89-184 (December 13, 1989).
3. U.S. DOE, Sandia National Laboratories/California, *Navy Landfill Solid Waste Water Quality Assessment Test Proposal* (March 1993).
4. U.S. DOE, Albuquerque Operations Office, *Navy Landfill Solid Waste Water Assessment Test Report* (June 1994).
5. State of California, Title 23 CCR, Division 3, Subchapter 16, "Underground Storage Tank Regulations" (1994).
6. U.S. DOE, Sandia National Laboratories/California, *Spill Prevention*

Environmental Program Information

Control and Countermeasure Plan
(December 1992).

7. U.S. EPA, Title 40 CFR, Part 112, *Oil Pollution Prevention* (July 1992, latest revision).

8. State of California, California
Administrative Code, Title 22, "California

Domestic Water Quality and Monitoring
Regulations" (1977).

9. EOA, Inc., *Storm Water Pollution Prevention Plan*, for Sandia National
Laboratories/California (January 1994).

Environmental Program Information

Table 5-1. SNL/California Site Waste Reduction Summary.

Waste Type	Waste Shipped in 1997 (kg)	Waste Shipped in 1998 (kg)	Change (%)
RCRA hazardous waste	24,897	21,624	-13.1
California-regulated (non-RCRA) hazardous waste	24,464	39,943	+63.3 ^a
Low-level mixed waste	0	1,189	N/A
Low-level radioactive waste	2,212	3,975	+79.7
TSCA (PCBs/asbestos)	57,329	10,434	-81.8
Biohazardous	1,773	296	-83.3
Sanitary waste	196,770	339,810	+72.7% ^b

^aThe increased is due to wastewater in a LECS that did not meet sewer permit limits under the City of Livermore's ordinance.

^bThe increase in sanitary waste is due to extensive renovation of several buildings. Routine sanitary waste (non-construction) totaled 196,100 kg.

Environmental Program Information

Table 5-2. SNL/California Site Recycling Activities (Estimated Values).

Recycled Item	Amount Recycled Per Year (in metric tons unless otherwise specified)					
	1993	1994	1995	1996 ^a	1997	1998
Office Paper	26.00	26.50	44.79 ^d	35.21 ^e	23.79 ^e	22.44
Miscellaneous Paper						0.81
Cardboard				8.92	20.28	14.03
Toner Cartridges	0.48	0.72	1.22	0.66	1.94	1.74
Aluminum Cans	0.40	0.46	0.30	0.27	0.54	0.26
Tires			0.53	0.53	1.17	0.54
Scrap Metal ^b	340.00 ^b	91.00 ^b	68.04 ^b	90.78 ^b	77.70 ^b	116.60
Waste Management						
- lead		c	c	c	c	e
- batteries	1.47	3.64	2.99	0.42	0.14	2.38
- engine oils	2.79	2.90	3.18	2.62	2.51	2.00
- fluorescent light tubes	0.20	6.54	4.54	0.40	2.00	0.68
- coolant	9.54	5.44	4.26	4.98	1.51	0.13
- photo related items containing silver (gross)	5.56	5.91	1.59	1.68	0.63	f
- laboratory glass			20 yd ^c	0.55	0.54	0.13
- empty drums						0.04
Yard Waste (disked into the soil)				NA	NA	NA

Note: NA = data not available

^aTotals as of December 2, 1996.

^bScrap metals are not segregated or weighed, but are sold to contractors by lot. The weight indicated is an estimation.

^cIncluded in scrap metal.

^dIncrease due to the additional types of paper that can be recycled.

^eDecrease due to use of double sided copying capabilities, TNT, electronic bulletin boards and other electronic memos, forms, etc.

^fNo longer cost effective to recycle.



Groundwater Sampling
Analytical Results

SNL/California issued the *Groundwater Protection Management Program Plan* on September 14, 1990,¹ to assure compliance with applicable Federal, State, and local environmental protection laws and regulations, Executive Orders, and internal department policies. The plan's objective is to document a management program for groundwater protection and remediation. Specifically, it addresses CERCLA, SARA, RCRA, and the Safe Drinking Water Act. The plan includes the following elements, as required by DOE Order 5400.1:²

- documentation of the quantity and quality of the groundwater,
- identification of sites that may be contaminated with hazardous substances, and
- a remedial action program, which is directed by the San Francisco Regional Water Quality Control Board and contained in DOE directives.

SNL/California designed the Groundwater Monitoring Program as a part of the Environmental Restoration Program (see Chapter 5 for description of this program) to monitor the effectiveness of the site's pollution control measures and to make sure that contaminants are not entering domestic water supplies.

The groundwater sampling schedule calls for a subset of the monitoring wells to be sampled each quarter, as indicated in Table 6-1. This schedule was followed for 1998.

Parameters for analysis are selected in accordance with San Francisco Regional Water Quality Control Board requirements. The location of the wells are shown in Figure 6-1.

Groundwater Sampling

Before sampling the wells' suitability to be sampled is determined by checking water levels and conditions. If sampling

was possible, the water was checked for pH, temperature, and specific conductivity before samples were taken. During 1998, SNL/California implemented micropurge sampling at a number of wells in order to reduce the amount of purged water generated. In addition, the sampling regimen was changed for the Arroyo Seco and Navy Landfill areas in accordance with guidance from the RWQCB. These changes are discussed below. Established quality assurance and quality control procedures were followed. These included chain of custody reporting and analyzing trip and equipment blanks to ensure the validity of the data.

LLNL reports data from groundwater monitoring wells installed on SNL/California property as part of the LLNL groundwater investigation project. Results are reported in LLNL's *Monthly Progress Report*. The San Francisco Regional Water Quality Control Board requires quarterly reports to summarize groundwater-related project activities at SNL/California and are defined in Board Orders 88-142 and 89-184 and in memoranda from the Board to the DOE.^{3,4}

Fuel Oil Spill Site

The Fuel Oil Spill site has 17 monitoring wells. Seven wells (FM-1 through FM-7) were installed in 1984 to assess the impact of a 59,000-gallon diesel fuel spill on the subsurface environment. However, persistent drought conditions lowered the water table, requiring the installation of ten deeper wells (FM-8 through FM-14, and FDG-1 through FDG-3) between 1986 and 1988.

All 17 of the Fuel Oil Spill monitoring wells had enough water for SNL/California to obtain a sample according to established procedures during all four quarters of 1998.

Arroyo Seco

In January 1986, four wells were installed at locations along the Arroyo Seco (AS-3 and AS-4 in Fig. 6-1), which traverses the

Groundwater

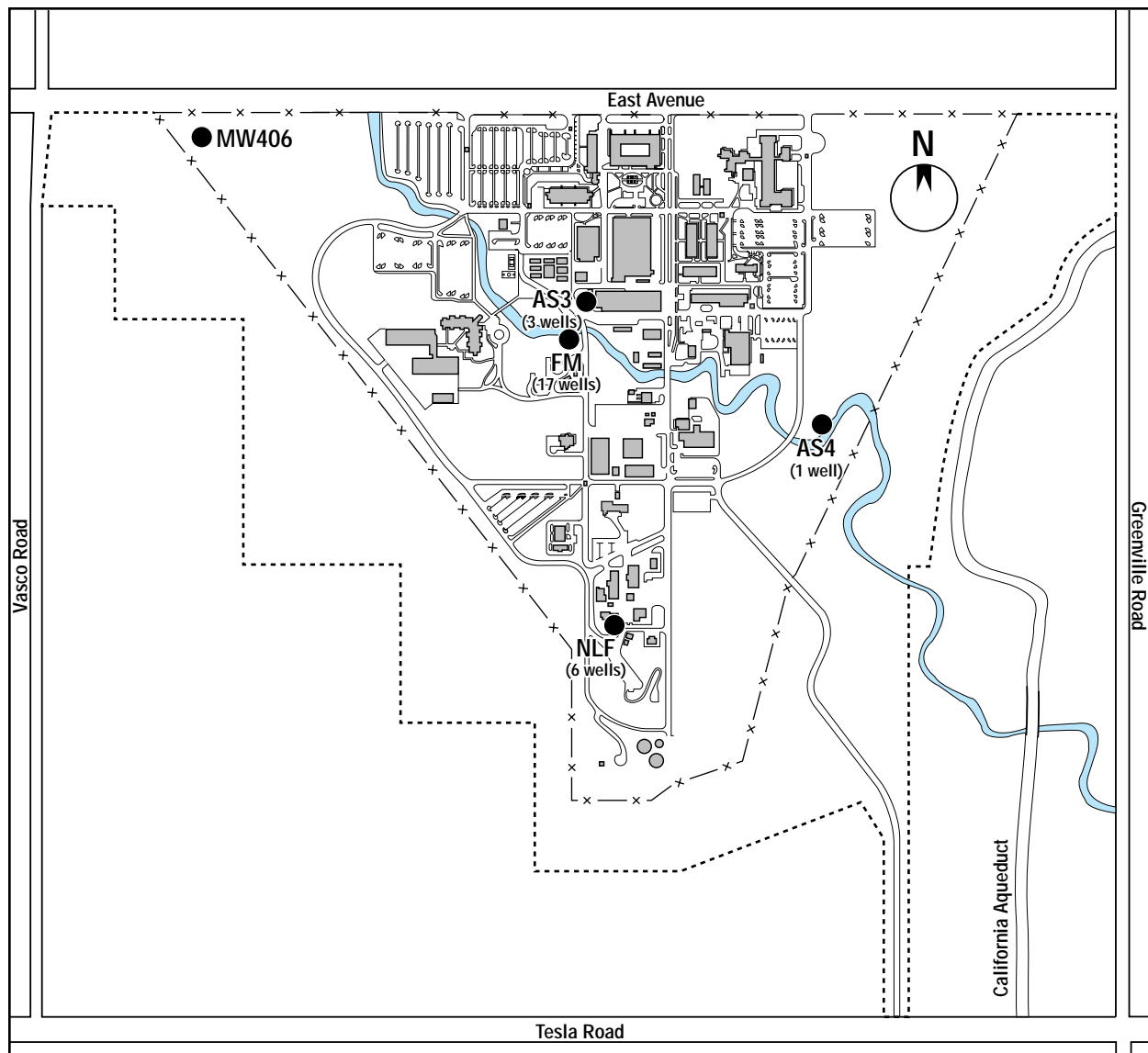


Figure 6-1. Groundwater monitoring well locations on the SNL/California site.

site. Locations of three of the wells (AS-3A, B, and C) were based on primary recharge areas and expected surface runoff points at the SNL/California site. Well AS-3C was installed at a much greater depth to monitor the third aquifer. (Water-bearing zones are numbered consecutively downward from the ground surface.) A fourth well, AS-4, installed upgradient of SNL/California, was intended to function as a back-ground well.

During the fourth quarter 1997, the sampling regimen for the Arroyo Seco wells was changed in accordance with RWQCB guidance. These wells are now sampled on an annual basis, during the second quarter. During the second quarter of 1998, wells AS-3B, AS-3C, and AS-4 were sampled. Well AS-3A did not recover sufficiently after purging to sample.

Navy Landfill

In January 1986, SNL/California installed one well (NLF-1) at the Navy Landfill site, an abandoned landfill used in the 1940s and 1950s for construction debris. SNL/California installed three additional wells (NLF-2 through NLF-4) in June 1988 (Fig. 6-1). In an effort to assess the elevated levels of chromium and nitrate observed in groundwater at the Navy Landfill site, SNL/California installed two additional monitoring wells (NLF-5 and NLF-6) in August 1993.

SNL/California received permission from the RWQCB to close the Navy Landfill in March of 1998. The closure activities included destruction of wells NLF-1, NLF-2, NLF-3, NLF-4, and NLF-5. Well NLF-6 remains on a quarterly sampling schedule, and was sampled during the second, third, and fourth quarters of 1998.

Buffer Zone

In 1987, as part of the expansion of the DOE security buffer zone, SNL/California acquired property that had been used as a gasoline service station and an auto repair shop. This land, known as the Trudell Auto Repair site, had subsurface contamination from previous activities. Restoration of the Trudell site was completed in August 1990, and the San Francisco Regional Water Quality Control Board approved site closure in November 1990. Although cleanup of the site is officially complete, SNL/California continues to monitor the area through quarterly sampling of well MW-406 (see Fig. 6-1).

MW-406 was sampled during all four quarters of 1998.

Analytical Results

In 1998, well NLF-6 was the only location in which carbon tetrachloride was detected. Carbon tetrachloride was detected during the third and fourth quarters at levels greater than the State maximum contaminant level (MCL) (0.5 mg/L) at 1.3 and 1.2 mg/L. SNL/California will continue to monitor for carbon tetrachloride.

Diesel was found in wells at the Fuel Oil Spill site during all four quarterly sampling events. Diesel concentrations at the Fuel Oil Spill site ranged from 50 µg/L to 610,000 µg/L and are graphed in Figure 6-2. Benzene concentrations above the state MCL (1 µg/L) were found in three of the Fuel Oil Spill site wells during at least one quarter. Benzene concentrations ranged from 1.1 to 1.9 µg/L. The wells where benzene was found had the highest levels of diesel. Since benzene is a component of #2 diesel fuel oil, benzene can also be expected in these wells.

Monitoring well MW-406 showed high concentrations of total dissolved solids. Groundwater from this well was above the state secondary drinking water

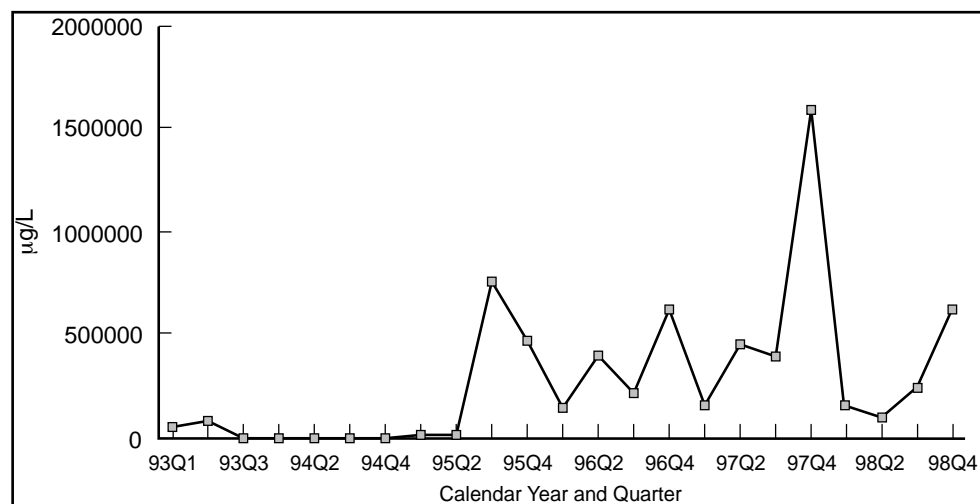


Figure 6-2. Highest diesel in any FOS well.

Groundwater

standard (500 mg/L) for two quarters. This is a measure of water quality only, and is indicative for the area.

Groundwater from well MW-406 showed levels of nickel, iron, and aluminum above the MCLs for at least one quarter. Highest detected concentrations were 0.21, 2.5, and 1.6 mg/L respectively (MCLs 0.1, 0.3, and 0.2 respectively). The MCLs for iron and aluminum, are secondary MCLs.

Samples were analyzed in 1998 for tritium. All samples for tritium were below the analytical detection limit. Figure 6-3 shows historical tritium monitoring data at the Navy Landfill site, Fuel Oil Spill site, and Arroyo Seco wells.

3. State of California, San Francisco Bay Region, Regional Water Quality Control Board, Order 88-142 (September 21, 1988).

4. State of California, San Francisco Bay Region, Regional Water Quality Control Board, Order 89-184 (December 13, 1989).

References

1. U.S. DOE, Sandia National Laboratories, Livermore, *Groundwater Protection Management Program Plan* (September 1990).
2. U.S. DOE, Order 5400.1, *General Environmental Protection Program* (November 1988).

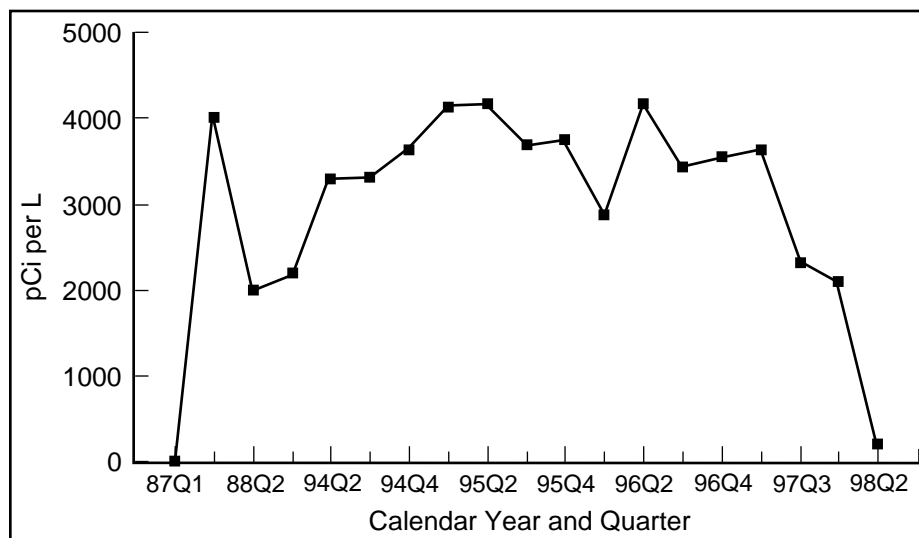


Figure 6-3. Highest tritium in SNL/California monitoring wells.

Table 6-1. Sample Analysis Schedule.

Area	Well ID	CCR Metals ^a	CCR General Minerals ^b	EPA 601	EPA 602/ BTEX	TPHD (8015)	RAD ^c	Water Elevation
Fuel Oil Spill	FM-1				Q	Q		Q
	FM-2				Q	Q		Q
	FM-3				Q	Q		Q
	FM-4				Q	Q		Q
	FM-5				Q	Q		Q
	FM-6				Q	Q		Q
	FM-7				Q	Q		Q
	FM-8				Q	Q		Q
	FM-9				Q	Q		Q
	FM-10				Q	Q		Q
	FM-11				Q	Q		Q
	FM-12				Q	Q		Q
	FM-13				Q	Q		Q
	FM-14				Q	Q		Q
	FDG-1				Q	Q		Q
	FDG-2				Q	Q		Q
	FDG-3				Q	Q		Q
Arroyo Seco	AS-3A	A	B	A		A	A	A
	AS-3B	A	B	A		A	A	A
	AS-3C	A	B	A		A	A	A
	AS-4	A	B	A		A	A	A
Navy Landfill	NLF-6	A	B	Q		A	A	A
Buffer Zone	MW-406	A	Q	Q	Q	Q	A	Q
	MW-11							Q

^aEPA Method 601 applies to halogenated volatile organic compounds.

^bEPA Method 602 applies to BTEX (benzene, toluene, ethylbenzene, xylenes), which are aromatic volatile organic compounds.

^cTPHD is diesel, which is analyzed according to EPA Method 8015.

^dCCR general minerals include bicarbonate, carbonate and hydroxide alkalinity, calcium, chloride, copper, magnesium, nitrate (as NO₃), pH, sodium, sulfate, specific conductivity, sulfate, total dissolved solids, total hardness, and zinc (Title 22 CCR 64433). Potassium is also included in the analyses.

^eCCR metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, fluoride salts, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. These are listed as Inorganic Persistent and Bioaccumulative Toxic Substances in Title 22 CCR 66261.24(a)(2)(A).

^fRAD (radioactivity) analyses include tritium, radium, and uranium.



Data Quality Assurance
Data Interpretation

SNL/California maintains an effluent monitoring and environmental surveillance program, as required by DOE Orders 5400.1 and 5400.5.^{1,2} These Orders specify quality assurance requirements consistent with DOE Order 5700.6B.³ The DOE has revised Order 5700.6B to 5700.6C.⁴ The Outreach, ES&H, and Security Center at SNL/California has developed and is implementing a Quality Assurance Management Plan consistent with the provisions of DOE requirements.⁵

Consistent with the requirements of the *Quality Assurance Management Plan*, the Environmental Surveillance Program has developed a Quality Assurance Project Plan, which describes how the *Quality Assurance Management Plan* will be implemented.⁶ To meet the most current guidance on quality assurance for environmental projects, the *Quality Assurance Project Plan* follows the guidance of DOE Implementation Guide G-830.120. Operating procedures supplement the Quality Assurance Project Plan and implementing provisions of the Quality Assurance Management Plan. Operating procedures specify requirements for environmental monitoring, LECS monitoring, and process wastewater sampling for compliance with Federal categorical pretreatment regulations.

The Environmental Operations Department incorporates normal data and supervisory reviews into routine operations. SNL/California's upper management performs management assessments, as required in the *Quality Assurance Management Plan*. Assessments identify problems that may keep an organization from achieving required goals or conforming to requirements. Finally, the *Quality Assurance Management Plan* provides for independent technical assessments to verify quality.

Data Quality Assurance

SNL/California assesses the quality of the data collected for the Environmental Operations Department by estimating the precision and accuracy of the data.

SNL/California estimates precision by collecting duplicate samples. The data obtained from the duplicate samples is compared to the data obtained from the routine samples. A confidence interval thereby can be calculated. The confidence interval represents the variability that exists in the monitoring system and the range of values around a reported data point, within which the actual value can be expected to lie.

Accuracy is estimated through analysis of samples containing a known amount of the constituent of interest. The result is compared to the known amount, and once again, a confidence interval is calculated. This confidence interval indicates the range of values within which the actual value can be expected to lie. In general, smaller confidence intervals represent more accurate and precise analyses.

The Environmental Operations Department has standardized methods for calculating confidence intervals and has established acceptance criteria for them. These methods and acceptance criteria are described in the procedure, *Data Validation and Verification for the Environmental Monitoring Program*.⁷ The acceptance criteria account for the confidence interval enlarging (i.e., the error associated with the analysis becomes greater) as the concentration of a constituent in a sample approaches the detection limit. For this reason, acceptance criteria that may be achievable at relatively high concentrations may not be achievable at very low concentrations. At very low levels, the presence of the constituent of interest may be detected, but not the quantity. To address this phenomenon, the EPA recommends that "practical quantitation limits" be established. The Environmental Operations

Department has established practical quantitation limits at ten times the detection limit for each constituent of interest. Therefore, the acceptance limits for precision and accuracy are progressive—the confidence interval can be larger near the detection limit and smaller as the practical quantitation limit is approached.

To facilitate the calculation of confidence intervals for accuracy and precision, the procedures for collecting environmental samples specify three types of quality control samples:

- *Duplicate Samples.* Duplicate samples are collected according to the same methods as the routine samples, and at the same time and location. These samples are used to assess the precision (repeatability) of the sample collection and analysis system.
- *Spiked Samples.* These samples resemble the routine samples collected, but contain a known amount of one or more of the constituents of interest. These samples are obtained from an independent laboratory that certifies the concentration of the included constituents.
- *Blank Samples.* Blank samples resemble the routine samples as closely as possible, but lack the constituent of interest. These samples are not used to assess accuracy or precision, but are important for assessing possible contamination of the samples during collection, transportation, and analysis.

Table 7-1 presents data from SNL/California's duplicate sampling. These data represent the precision of the combined sampling and analytical processes. All t-tests between routine and duplicate samples except for biochemical oxygen demand, showed no significant difference at the 95% confidence level. However, the 95% confidence intervals for chemical oxygen demand, and TSS in wastewater do not meet the acceptance

criteria of having a width of less than 50% of the routine sample average. An investigation into these phenomenon indicates that the most probable reason for the discrepancies is the extraordinary heterogeneity of the wastewater samples. Care is taken when collecting duplicate samples, so the differences noted are taken to reflect the true variable nature of the wastewater. The ratio of duplicate to routine samples for phenol in wastewater does not meet the acceptance criteria. This is also an indication of the variability of the wastewater. The ratios of duplicate to routine samples for iron and aluminum in storm water also do not meet the acceptance criteria, indicating the variable nature of the storm water.

Data Interpretation

Once the precision and accuracy of the data have been established, and the acceptance criteria have been met, the data must be interpreted. Data Analysis for the Environmental Monitoring Program describes SNL/California's methods for interpreting data.⁸ These methods fall into several categories:

- *Determining averages and standard deviations.* Averages and standard deviations are useful as summaries of data collected during the year. The usual methods for calculating averages and standard deviations assume that the data have a "normal" (bell curve) distribution. However, many environmental data do not follow a normal distribution, and the usual methods of calculating averages and standard deviations would be misleading for these data sets. Therefore, all data sets are tested for normality. If the data are found to be not normally distributed, then the average and standard deviation appropriate for a data set with a lognormal distribution are calculated. (Most environmental data follow a lognormal distribution if they are not distributed normally.) Data sets with ten or fewer

data points are treated as normally distributed, with no checks of the distribution, because more data points are needed to describe the distribution accurately.

- *Testing for outliers.* SNL/California includes outlying data in the data sets, unless they can be attributed to a specific cause (such as laboratory contamination of the sample). SNL/California personnel use box plots (a statistical method) to determine outliers.
- *Comparing data.* If possible, SNL/California personnel compare data collected on or near the SNL/California site and data collected at “background”—or distant—locations. If concentrations on or near the site are observed at a higher concentration than at distant locations, the site may be assumed to be the source of observed hazardous or radioactive materials in the environment. Conversely, if concentrations on or near the site are similar to (or lower than) concentrations at distant locations, the site may be assumed not to be the source of hazardous or radioactive materials in the environment. SNL/California personnel compare concentrations by using t-tests (statistical tests) or by analysis of variance techniques to determine if any observed differences are statistically significant.
- *Determining compliance with standards.* If regulatory standards have been established for hazardous or radioactive material concentrations in an environmental medium, SNL/California compares monitoring results to the standard. Because a single data point is associated with high uncertainty, SNL/California personnel use the confidence interval for precision, as calculated above, for comparison. If the 95% confidence interval around the observed value includes values at or above the regu-

latory standard, then the standard may have been exceeded. The data are investigated further to confirm, if possible, whether or not the standard was indeed exceeded. If the entire confidence interval is above the regulatory limit, then we assume the standard was exceeded.

- *Determining values below the analytical detection limit.* Most analytical methods cannot state definitively that the concentration of a hazardous or radioactive material is zero. Most analytical methods have a “lower limit of detection,” below which material presence cannot be ascertained. This lower detection limit usually is defined as the concentration at which the presence of the material can be detected with 99% statistical certainty. These values are shown with a “less than” symbol (<) preceding the value. They cannot be used in the normal statistical calculations described above because they represent ranges instead of discrete values. To perform statistical calculations on data sets containing these values, SNL/California personnel use the following methods:
 - If more than one-third of the data set consists of detection limit values, SNL/California reports the median and median absolute deviation of the data set, instead of the average and standard deviation.
 - If less than one-third of the data set consists of detection limit values, SNL/California calculates averages and standard deviations using the detection limit as a normal result. (This method is conservative because it really represents the highest possible value for the data.)



References

1. U.S. DOE, Order 5400.1, *General Environmental Protection Program* (November 1988).
2. U.S. DOE, Order 5400.5, *Radiation Protection of the Public and the Environment* (February 8, 1990) (Change 2, January 7, 1993).
3. U.S. DOE, Order 5700.6B, *Quality Assurance* (March 1989).
4. U.S. DOE, Order 5700.6C, *Quality Assurance* (August 21, 1991) (Change 1, May 10, 1996).
5. U.S. DOE, Sandia National Laboratories/California, *Quality Assurance Management Plan* (1991).
6. R. C. Holland, *Environmental Monitoring Program Quality Assurance Project Plan*, Sandia National Laboratories/California, SAND93-8010 (June 1993).
7. U.S. DOE, Sandia National Laboratories/California, *Data Validation and Verification for the Environmental Monitoring Program* (January 1994).
8. U.S. DOE, Sandia National Laboratories/California, *Data Analysis for the Environmental Monitoring Program* (January 1994).

Table 7-1. Quality Assurance—Duplicate Sampling, Selected Parameters on SNL/California Collected Samples.

Medium	Analysis	Confidence Interval (95%) ^a	Ratio ^b
Wastewater			
	Biological oxygen demand	4.09/71.74	— ^d
	Chemical oxygen demand	-181/66.58	— ^d
	Total suspended solids	-331/51.24	— ^d
	Total dissolved solids	-15.25/8.58	— ^d
	Specific conductivity	-27.54/14.20	— ^d
	Oil and grease	-1.76/0.12	— ^d
	Chromium	— ^c	1.08
	Copper	5.99/±13.93	— ^d
	Silver	— ^c	1.75
	Zinc	-0.15/0.03	— ^d
	Chloroform	-2.04/0.48	— ^d
	Phenol	— ^c	1.36
Storm Water Runoff			
	pH	— ^c	0.99
	Specific conductivity	— ^c	1.04
	Total suspended solids	— ^c	1.03
	Zinc		1.10
	Iron		1.47
	Aluminum		1.56

^aOnly calculated for data sets with more than eight valid data pairs.

^bOnly calculated for data sets with less than eight valid data pairs. The value is the ratio of quality assurance sample/routine sample.

^cNot calculated—less than eight valid data pairs available.

^dNot calculated—more than eight valid data pairs available.



Acronyms and Abbreviations
Technical Terms
Radiological Units

Acronyms and Abbreviations

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BAAQMD	Bay Area Quality Management District
BOD	biological oxygen demand
BTEX	benzene, toluene, ethylbenzene, xylenes
CAA	Clean Air Act (Federal)
Cal/EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CN	cyanide
COD	chemical oxygen demand
CWA	Clean Water Act (Federal)
DCG	Derived Concentration Guide (DOE)
DOE	Department of Energy
DWS	drinking water standard
EDE	effective dose equivalent
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ES&H	environment, safety, and health
LECS	Liquid Effluent Control System
LLNL	Lawrence Livermore National Laboratory
LWRP	Livermore Water Reclamation Plant
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
O&G	oil and grease
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SCEC	Sandia/California ES&H Council
SI	International System of Units
SNL	Sandia National Laboratories
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TRI	Toxic Release Inventory

Glossary

TSCA	Toxic Substance Control Act
TSS	total suspended solids

Technical Terms

accuracy	The closeness of the result of a measurement to the true value of the quantity measured.
air particulates	Airborne particles. These may include dust, dirt, and pollutants that occur as particles, and any pollutants that may be associated with or carried on the dust or dirt.
aliquot	A portion of a sample taken for analysis.
alpha particle	A charged particle (identical to the helium nucleus) comprising two protons and two neutrons that are emitted during decay of certain radioactive atoms. Alpha particles are stopped by several centimeters of air or a sheet of paper.
ambient air	The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. It does not include the air next to emission sources.
aquifer	A saturated layer of rock or soil below the ground surface that can supply usable quantities of ground water to wells and springs. Aquifers can be a source of water for domestic, agricultural, and industrial uses.
arroyo	An intermittent or seasonal stream.
background radiation	Ionizing radiation from natural sources. It may include cosmic radiation; external radiation from naturally occurring radioactivity in the earth (terrestrial radiation), air, and water; internal radiation from naturally occurring radioactive elements in the human body; and radiation from medical diagnostic procedures.
best management practice	Any method, process, or procedure developed to prevent and/or reduce pollutants discharged to the environment.
beta particle	A charged particle (identical to the electron), which is emitted during decay of certain radioactive atoms. Most beta particles are stopped by ≤ 0.6 cm of aluminum.
categorical process	An industrial process, which discharges wastewater and is regulated under Title 40 CFR, Part 403.
collective effective dose equivalent	The sum of the effective dose equivalents of all individuals in an exposed population within a certain radius; expressed in units of person-rem (or person-sievert).
contaminant	Any hazardous or radioactive material present in an environmental medium, such as water or vegetation.
controlled area	Any Laboratory area to which access is controlled to protect individuals from exposure to radiation and radioactive materials.

cosmic radiation	High-energy particulate and electromagnetic radiation that originates outside the earth's atmosphere. Cosmic radiation is part of natural background radiation.
discharge	A release into an area not controlled by SNL/California.
dose	A term denoting the quantity of radiation energy absorbed.
dose, absorbed	The energy imparted to matter by ionizing radiation per unit mass of irradiated material. (The unit of absorbed dose is the rad.)
dose, effective	The hypothetical whole-body dose that would give the same risk of cancer mortality and/or serious genetic disorder as a given exposure and that may be limited to just a few organs. The effective dose equivalent is equal to the sum of individual organ doses, each weighted by the degree of risk that the organ dose carries. For example, a 100-mrem dose to the lung, which has a weighting factor of 0.12, gives an effective dose that is equivalent to 12 mrem (100×0.12).
dose, equivalent	A term used in radiation protection that expresses all types of radiation (alpha, beta, and so on) on a common scale for calculating the effective absorbed dose. It is the product of the absorbed dose in rads and certain modifying factors. (The unit of dose equivalent is the rem.)
dose, maximum boundary	The greatest dose commitment, considering all potential routes of exposure from a facility's operation, to a hypothetical individual who is in an uncontrolled area where the highest dose rate occurs. It assumes that the hypothetical individual is present 100% of the time (full occupancy), and it does not take into account shielding (for example, by buildings).
dose, maximum individual	The greatest dose commitment, considering all potential routes of exposure from a facility's operation, to an individual at or outside the Laboratory boundary where the highest dose rate occurs. It takes into account shielding and occupancy factors that would apply to a real individual.
dose, population	The sum of the radiation doses to individuals of a population. It is expressed in units of person-rem. For example, if 1,000 people each received a radiation dose of 1 rem, their population dose would be 1,000 person-rem.
dosimeter	A portable detection device for measuring the total accumulated exposure to ionizing radiation. See also <i>thermoluminescent dosimeter</i> .
downgradient	In the direction of groundwater flow from a designated area of interest; analogous to downstream.
effective dose equivalent	Abbreviated EDE; the summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health risk of the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The EDE includes the

Glossary

	committed EDE from internal deposition of radionuclides and the EDE due to penetrating radiation from sources external to the body; it is expressed in units of rem (or sievert).
effluent	A liquid or gaseous waste discharged to the environment.
emission	A gaseous or liquid stream containing one or more contaminants. The verb form, emit, means the act of discharging a contaminant or pollutant into the environment.
environmental remediation	The process of restoring a contaminated area to a noncontaminated or safe condition.
exposure	A measure of the ionization produced in air by x or gamma radiation. (The unit of exposure is the roentgen.)
external radiation	Radiation originating from a source outside the body.
extractable pollutants	Pollutants that can be removed from a contaminated sample by passing water through the sample.
gamma radiation	Short-wavelength electromagnetic radiation of nuclear origin that has no mass or charge. Because of its short wavelength (high energy), gamma radiation can cause ionization. Other electromagnetic radiation (such as microwaves, visible light, and radio waves) have longer wavelengths (lower energy) and cannot cause ionization.
groundwater	A subsurface body of water in the zone of saturation (where soil sediments have become saturated with water).
half-life, radioactive	The time required for the activity of a radioactive substance to decrease to half its value by inherent radioactive decay. After two half-lives, one-fourth of the original activity remains ($1/2 \times 1/2$); after three half-lives, one-eighth ($1/2 \times 1/2 \times 1/2$); and so on.
hazardous waste	Waste exhibiting any of the following characteristics: ignitability, corrosivity, reactivity, or EP-toxicity (yielding toxic constituents in a leaching test). Because of its concentration, quantity, physical, or chemical characteristics, it may: 1) cause or significantly contribute to an increase in mortality rates or cases of serious irreversible illness; or 2) pose a substantial present or potential threat to human health or the environment when improperly treated, stored, transported, disposed of, or handled.
internal radiation	Radiation from a source within the body as a result of deposition of radionuclides in body tissues by processes such as ingestion, inhalation, or implantation. Potassium (^{40}K), a naturally occurring radionuclide, is a major source of internal radiation in living organisms.
lysimeter	A device for sampling soil moisture in the unsaturated zone. See <i>vadose zone</i> .
nonattainment area	An area that does not meet the National Ambient Air Quality Standards.

non-storm water	Any water flow that is not entirely composed of rain.
nuclide	A species of atom characterized by what constitutes the nucleus, which is specified by the number of protons, number of neutrons, and energy content; or, alternatively, by the atomic number, mass number, and atomic mass. To be regarded as a distinct nuclide, the atom must be able to exist for a measurable length of time.
organic compound	A chemical whose primary constituents are carbon and hydrogen.
organochloride	An organic compound in which one or more of the hydrogen atoms have been replaced with a chlorine atom.
Part B permit	The second, narrative section submitted by hazardous waste generators in the RCRA permitting process. It details the procedures followed at a facility to protect human health and the environment.
pH	A measure of hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH less than 7, basic solutions have a pH greater than 7, and neutral solutions have a pH of 7.
piezometer	Generally, a small-diameter, nonpumping well used to measure the elevation of the water table or potentiometric surface (an imaginary surface that represents the static head of groundwater and is defined by the level to which water will rise).
pollutant	Any hazardous or radioactive material present in an environmental medium, such as water or vegetation. For storm water, a pollutant is a material that can be mobilized in water, including (but not limited to) litter, soil, oil and grease, pesticides, and fertilizer.
pretreatment	Any process used to reduce a pollutant load before wastewater enters the sewer system.
pretreatment regulations	National wastewater pretreatment regulations (Title 40 CFR, Part 403) adopted by the EPA in compliance with the 1977 amendments to the Clean Water Act, which required that the EPA establish pretreatment standards for existing and new industrial sources.
priority pollutants	A set of organic and inorganic chemicals identified by the EPA as indicators of environmental contamination.
purgeable pollutants	Pollutants that can be removed from a sample by passing nitrogen gas through the sample.
radiation protection standard	Limits on radiation exposure regarded as necessary for protection of public health. These standards are derived based on acceptable levels of risk to individuals.
radiation	Energy emitted from the nucleus of an atom in the form of waves or particles.
radioactivity	The property or characteristic of a nucleus of an atom to spontaneously disintegrate accompanied by the emission of energy in the form of radiation.

Glossary

radiological	Arising from radiation or radioactive materials.
radionuclide	An unstable nuclide. See nuclide and radioactivity.
recharge zone	An area of the ground in which surface water migrates to the ground-water.
remediation	See <i>environmental remediation</i> .
sanitary sewer system	A system that collects or conveys domestic and industrial wastewater off site. The SNL/California system connects to the LLNL sanitary sewer system, and the combined effluent then connects to the City of Livermore municipal sewer system. The effluent is treated at the Livermore Water Reclamation Plant.
scintillation cocktail	A solution of organic compounds that emits light upon interacting with radiation. For the purposes of this report, it is used primarily for the tritium analysis.
source	Any operation or equipment that produces and/or emits pollutants (e.g., pipe, ditch, well, or stack).
storm drain system	A collection of inlets, catch basins, channels, and trenches, which transport rain from paved areas on the SNL/California site to the Arroyo Seco.
storm water runoff	Rainfall on paved areas that flows over the ground surface.
terrestrial	Pertaining to or deriving from the earth.
terrestrial radiation	Radiation emitted by naturally occurring radionuclides, such as ^{40}K ; the natural decay chains ^{235}U , ^{238}U , or ^{232}Th ; or cosmic-ray-induced radionuclides in the soil.
thermoluminescent dosimeter	A type of dosimeter. After being exposed to radiation, the material in the dosimeter (lithium fluoride) luminesces upon being heated. The amount of light the material emits is proportional to the amount of radiation (dose) to which it was exposed. See also dosimeter.
tritium	A radionuclide of hydrogen with a half-life of 12.3 years. The very low energy of its radioactivity decay makes it one of the least hazardous radionuclides.
uncontrolled area	An area beyond the boundaries of a controlled area. See <i>controlled area</i> .
upgradient	Opposite of the direction of groundwater flow from a designated area of interest. Analogous to upstream.
uranium	A metallic element that is highly toxic and radioactive.
uranium, depleted	Uranium consisting primarily of ^{238}U and having less than 0.72 wt% ^{235}U . Except in rare cases occurring in nature, depleted uranium is man-made.
uranium, total	The amount of uranium in a sample, assuming that the uranium has the isotopic content of uranium in nature (99.27 wt% ^{238}U , 0.72 wt% ^{235}U , and 0.0057 wt% ^{234}U).

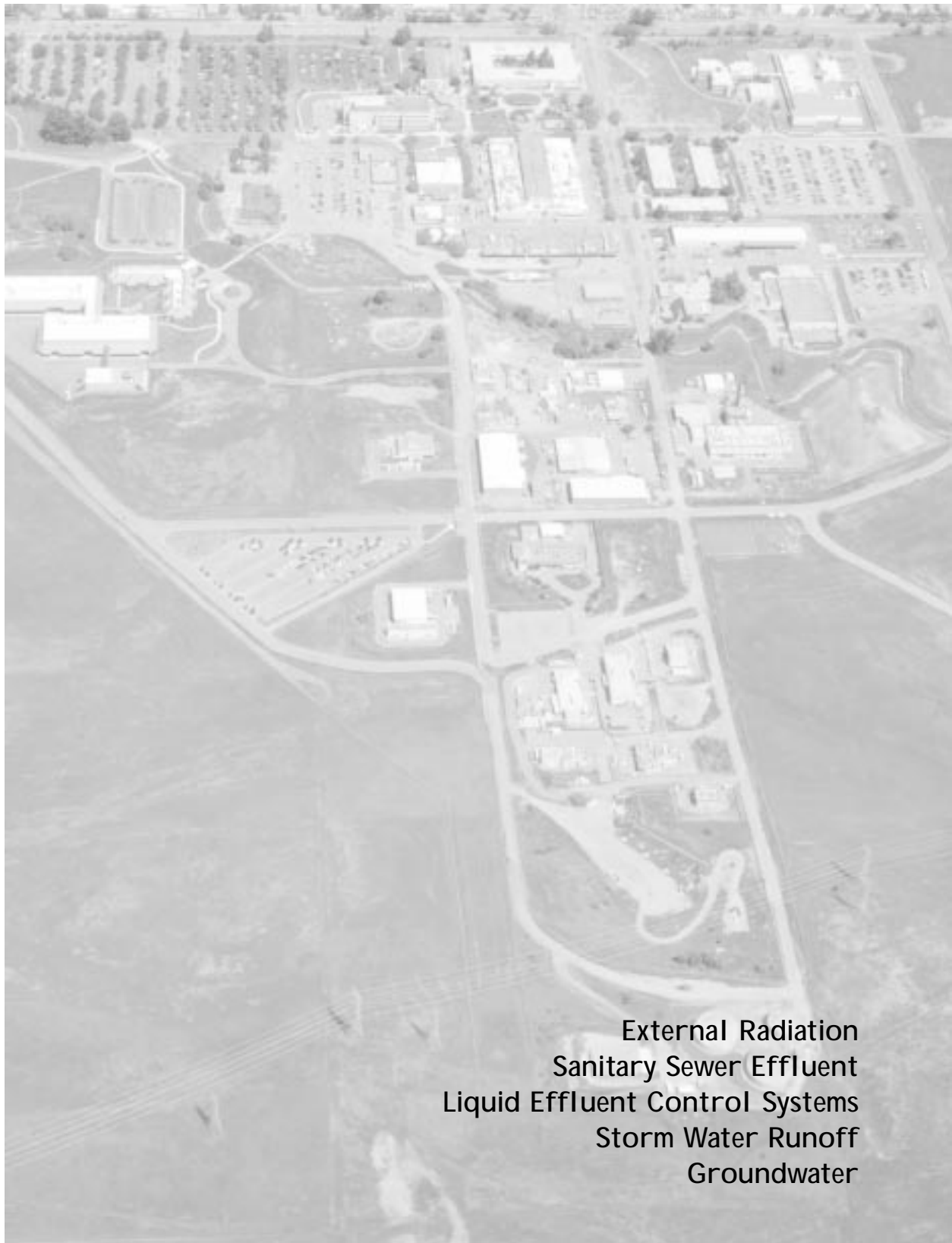
vadose zone	The partially saturated or unsaturated region of the ground above the water table that does not yield water to wells.
wind rose	A diagram that shows the frequency and intensity of wind from different directions at a particular place.
Zone 7	The common name for the Alameda County Flood Control and Water Conservation District. Zone 7 is the water management agency for the Livermore-Amador Valley with responsibility for water treatment and distribution. Zone 7 is also responsible for management of agricultural and surface water and the groundwater basin.

Radiological Units

becquerel (Bq)	Unit of radioactive decay equal to one disintegration per second. (SI unit)
curie (Ci)	Unit of radioactive decay equal to 2.22×10^{12} disintegrations per minute. (conventional unit)
millirem (mrem)	Unit equal to 10^{-3} rem. See <i>rem</i> .
person-rem	The unit of population dose, which expresses the sum of radiation exposures received by a population. For example, two persons, each with a 0.5-rem exposure, receive 1 person-rem, and 500 people, each with an exposure of 0.002 rem, also receive 1 person-rem.
rad	A unit of absorbed dose from ionizing radiation (0.877 rad/R).
rem	Stands for roentgen equivalent man; a unit of ionizing radiation, equal to the amount of radiation needed to produce the same biological effect to humans as 1 rad of high-voltage x-rays. It is the product of the absorbed dose (rad), quality factor (Q), distribution factor, and other necessary modifying factors. It describes the effectiveness of various types of radiation in producing biological effects.
roentgen (R)	A unit of radiation exposure that expresses exposure in terms of the amount of ionization produced by x or gamma rays in a volume of air. One roentgen (R) is 2.58×10^{-4} coulombs per kilogram of air.
sievert (Sv)	A unit of radiation dose equivalent. The Sv is the SI unit equivalent to the rem. It is the product of the absorbed dose (gray), quality factor (Q), distribution factor, and other necessary modifying factors. It describes the effectiveness of various types of radiation to produce biological effects; $1 \text{ Sv} = \text{Gy} \times Q \times N = 100 \text{ rem}$.
gray (GY)	A unit of absorbed dose from ionizing radiation; $1 \text{ Gy} = 100 \text{ rad}$.



Appendix A – Laboratory Procedures



External Radiation
Sanitary Sewer Effluent
Liquid Effluent Control Systems
Storm Water Runoff
Groundwater

Chemical and physical analyses on LECS and groundwatersamples are done by a state-certified commercial laboratory.

For a commercial laboratory to be considered for use by SNL/California, it must be accredited by the State Department of Health Services.

Following is a brief synopsis of the analyses done on samples from each of the environmental media.

External Radiation

The dosimeters collected by LLNL are processed by LLNL's Hazards Control Department, using automated equipment. The dosimeters are received from the Monitoring Group and stored in a lead shield until they are processed.

The dosimeters collected by SNL/California personnel are processed by the Health Instrumentation Department at SNL/New Mexico. These dosimeters are also stored in a lead shield before processing.

Sanitary Sewer Effluent

Tritium

Sewer samples are distilled in preparation for tritium counting. SNL/California's Health Physics organization does the counting by liquid scintillation.

Other Analyses

The metals and organics samples are sent to a State-certified, commercial laboratory, where they are processed in accordance with EPA protocols. The analyses performed on sanitary sewer effluent samples are EPA method 624 (volatile organics), EPA method 625 (semivolatile organics), EPA method 608 (pesticides), metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn), oil and grease, chemical oxygen demand, biological oxygen demand, cyanide, total dissolved solids, and total suspended solids.

Liquid Effluent Control Systems

Metals

Samples are sent to a state-certified commercial laboratory.

Metals analyses are performed by Inductively Coupled Plasma-Atomic Emission Spectra (ICP-AES) in accordance with internal Environmental Protection Department procedures, which are compatible with applicable EPA procedures.

Storm Water Runoff

Samples are sent to a State-certified, commercial laboratory, where they are processed in accordance with EPA protocols. The analyses performed on storm water runoff samples are EPA method 608 (pesticides), EPA method 624 (volatile organics), EPA method 625 (semivolatile organics), metals (As, Cd, Cr, Cu, Pb, Ni, Ag, Zn), pH, total suspended solids, specific conductivity, oil and grease. SNL/California performed the tritium analyses.

Groundwater

Groundwater samples are analyzed by a State-certified commercial laboratory. The samples are processed in accordance with EPA protocols. The analyses performed on groundwater samples are EPA method 624 (volatile organics), EPA method 625 (semivolatile organics), CCR Title 22 organics, metals (As, Ba, Be, Cd, Cr, Pb, Se, Ag), gross alpha, gross beta, and tritium.



DISTRIBUTION:

DOE Headquarters Office of
Environmental Compliance, EH-22 (1)
Office of Environmental Guidance,
EH-33 (1)

Office of Environmental Policy and
Assistance, EH-41 (3)
Office of RD&T, DP-13 (2)
Office of Technical and Environmental
Support, DP-45 (1)

Office of Environmental Management,
EM-34 (1)
Office of Southwestern Area Programs,
EM-45 (1)
Washington, DC

US Department of Energy
Albuquerque Operations Office
AL/Environmental Protection Division (3)
PO Box 5400
Albuquerque, NM 87185-5400

US Department of Energy
San Francisco Operations Office (8)
Attn: J. T. Davis
J. P. Juetten
W. W. Warner
E. Ballard
R. R. Koenhaver
E. Bower
M. Brown
1301 Clay St.
Oakland, CA 94612

US Department of Energy
Attn: D. Hoff
785 Department of Energy Place, MS 1146
Idaho Falls, ID 83401-1562

US Environmental Protection Agency
Region IX (3)
Attn: M. Dermer
D. McGovern
S. Rosenblum
75 Hawthorne Street
San Francisco, CA 94105

Argonne National Laboratory
Attn: Norbert Golchert
9700 S. Cass Avenue
Building 200, Room B-117
Argonne, IL 60439

Battelle Pacific Northwest Laboratories
Attn: Roger Dirkes
PO Box 999
Richland, WA 99352

Battelle Pacific Northwest Laboratories
Attn: Eva Hickey
PO Box 999, MS K-3-66
Richland, WA 99352

Brookhaven National Laboratory
Attn: Jan Naidu
Building 129B
Upton, NY 11973-5000

EG&G Mound Applied Technologies
Attn: Daniel G. Cafagno
PO Box 3000
Miamisburgh, OH 45343

Lawrence Berkeley National
Laboratory (2)
Attn: R. Pauer
M. Ruggieri
One Cyclotron Road
Berkeley, CA 94720

Park T. Owen
Remedial Action Program Information
Center
Lockheed Martin Corp.
PO Box 2003
Oak Ridge, TN 37831

Los Alamos National Laboratory (2)
Environmental Surveillance Group
Attn: Lars Soholt
Tom Buhl
MS-K490, PO Box 1663
Los Alamos, NM 87545

Los Alamos National Laboratory
Attn: Jim Craig, K-485
PO Box 1663
Los Alamos, NM 87545

Distribution

Oak Ridge National Laboratory
Attn: Paul Rohwer
Building 4500 S.
MS-6102
Oak Ridge, TN 37831-6102

Oak Ridge National Laboratory
Attn: John Murphy
PO Box 2008
MS-6198
Oak Ridge, TN 37831-6198

Rockwell International, Rocky Flats Plant
Attn: George H. Setlock
PO Box 464
Golden, CO 80402-0464

Assemblymen Richard Rainey,
15th District
1948 Mt. Diablo Road
Walnut Creek, CA 94596

Congresswoman Ellen Tauscher,
10th District
1801 N. California, Suite 103
Walnut Creek, CA 94596

Office of Congresswoman Ellen Tauscher
1440 Longworth
House Office Building
Washington DC 20515

Supervisor Ed Campbell
Alameda County Board of Supervisors,
District One
1221 Oak St.
Oakland, CA 94612

Mayor Cathie Brown
1098 Angelica St.
Livermore, CA 94550

Savannah River Plant
Environmental Monitoring
Health Protection Department
Attn: Jimm Heffner
Building 735A
Aiken, SC 29809

Fermilab
Attn: Don Cossairt
PO Box 500
Batavia, IL 60510

California Department of Health Services
Radiologic Health Branch
Attn: E. Bailey
Stephen Woods
Stephen Hsu
PO Box 942732
MS 178
Sacramento, CA 94234-7320

California Department of Health Services
Environmental Management Branch
Attn: J. Wong
2151 Berkeley Way, Room 133
Berkeley, CA 94704

California Regional Water
Quality Control Board
San Francisco Bay Region
Attn: Lester Feldman
Richard Hiett
2101 Webster St.
Oakland, CA 94612

Livermore Water Reclamation Plant (2)
Attn: S. Gittings
D. Greenwood
101 West Jack London Boulevard
Livermore, CA 94550

Bay Area Quality Management District
Attn: James Guthrie, Director of
Enforcement Services
939 Ellis Street
San Francisco, CA 94109

Alameda County Health Care Services
Agency
Dept. of Environmental Health Services
Attn: Robert Weston
1131 Harbor Bay Pkwy.
Alameda, CA

Congressional Information Services	MS 0101	P. Robinson, 1
Attn: Joy Haftel	MS 0141	B. Krauss, 11300
4520 East-West Highway	MS 0141	R. J. Park
Suite 800	MS 0361	L. Jones, 7000
Bethesda, MD 20814	MS 1306	A. K. Jones, 7574
	MS 1311	T. A. Culp, 7575
Vallecitos Nuclear Center	MS 1311	S. A. Hwang, 7575
Attn: Frank Mindt	MS 1315	T. E. Blejwas, 7500
PO Box 460	MS 1315	R. W. Rohde, 7501
Pleasanton, CA 94566	MS 1309	Environmental Information Management, 7512
	MS 9001	M. E. John, 8000
Mr. Daniel Murphy	MS 9031	P. E. Brewer, 8500
California EPA	MS 9004	J. Vitko, 8100
Department of Toxic Substances Control	MS 9031	L. A. Hiles, 8800
Region 2, Facility Permitting Branch	MS 9054	W. J. McLean, 8300
700 Heinz Avenue, Suite 200	MS 9111	B. L. Schrader, 8528 (3)
Berkeley, CA 94710	MS 9131	B. A. Condouris, 8528
	MS 9131	S. K. Simmons, 8528
Mike Miller	MS 9221	S. Orth, 8822
Public Services Director	MS 9221	J. Bartel, 8816
City of Livermore	MS 9221	S. Raubfogel, 8816
3500 Robertson Park Rd.	MS 9221	R. C. Holland, 8816 (50)
Livermore, CA 94550	MS 9221	J. Harris, 8816
	MS 9221	L. Gardizi, 8816
Jerry Peeler	MS 9221	D. A. Wright, 8821
City Manager, City of Livermore	MS 9221	T. B. Garcia, 8821
1052 S. Livermore Ave.	MS 9221	M. E. Brynildson, 8816
Livermore, CA 94550	MS 9401	M. T. Dyer, 8700
Mike & Ann Mueller	MS 9018	Central Technical Files, 8940-2 (3)
2693 South Vasco Road	MS 0899	Technical Library, 4916 (1)
Livermore, CA 94550	MS 9021	Technical Communications Dept. 8815/Technical Library, 4916, MS 0899
K. Surano, LLNL, L-629	MS 9021	Technical Communications Dept. 8815, for DOE/OSTI (1)
H. L. Galles, LLNL, L-626		
W. McConachie, LLNL, L-627		
LLNL Public Information Office, L-790		